

# Introduction to the USDA Forest Inventory Analysis Program: A Bird's Eye Overview

Mark D. Nelson

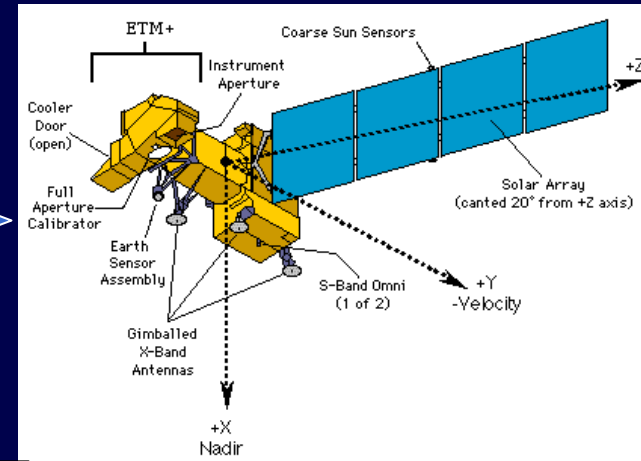
PIF Conservation Design Workshop  
12 April 2006  
St. Louis, MO

# A Bird's Eye Overview...

Eagle-Eye



NASA: Landsat 7



Forest Soils Data



Ovenbird-Eye

# Forest Inventory & Analysis (FIA)

Forest Inventory & Analysis - Microsoft Internet Explorer provided by USDA Forest Service

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## Forest Inventory and Analysis

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Welcome to our site, we are

### ... the pulse takers of the nation's forests

Forest Inventory and Analysis (FIA) collects, analyzes, and reports information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing.

Our unit is responsible for inventorying more than 82 million acres of forest land spread across 11 Midwestern States; Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, South Dakota and Wisconsin.

This information can be used in many ways, such as in evaluating wildlife habitat conditions, assessing the sustainability of ecosystem management practices, and supporting planning and decision-making activities undertaken by public and private enterprises.

The FIA Program combines this information with related data on insects, diseases, and other types of forest damages and stressors to assess the health, condition, and potential future risks to forests.

Hot off the press!



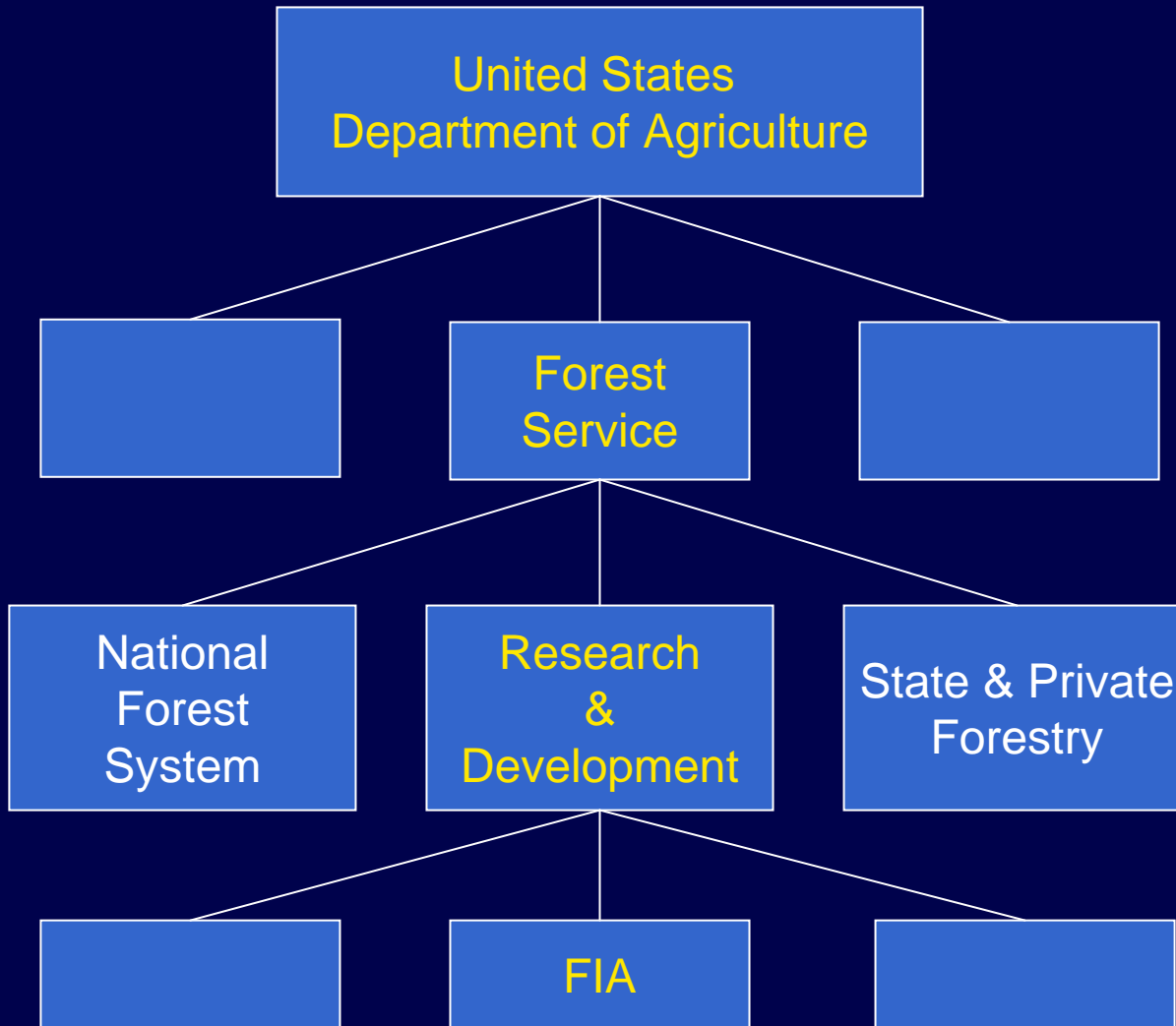
Focus on Wildfires.  
**MORE**

**New!**  
**FIA**  
**Plot Tracking System**



Internet

# Forest Inventory & Analysis (FIA)





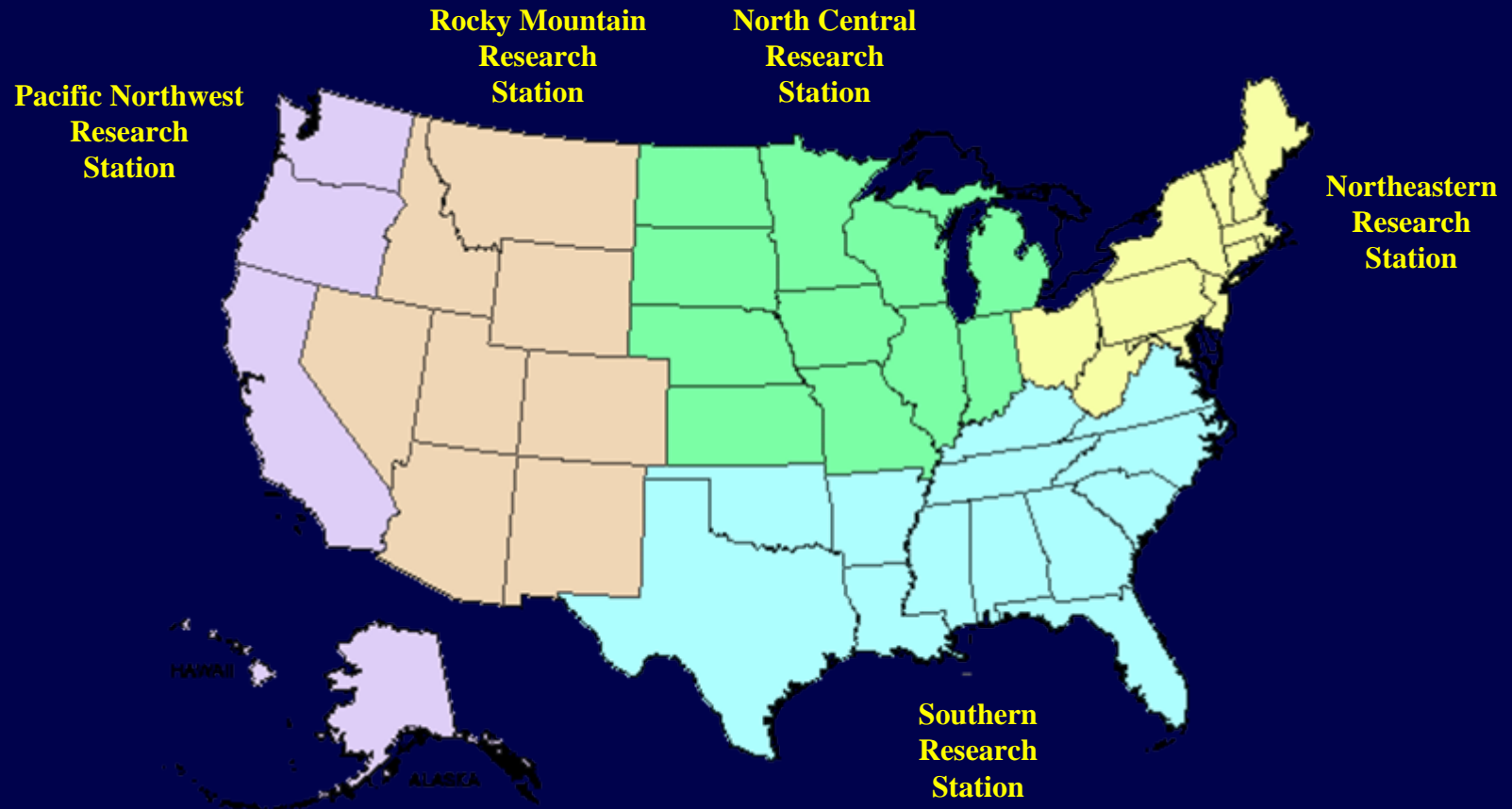
# Forest Inventory and Analysis (FIA)

## *Mission:*

To conduct forest inventories of the United States to estimate:

- the extent (area) of forest land
- the volume, growth, and removal of forest resources
- the health and condition of the forest

# Forest Inventory and Analysis Regions



# Annual Forest Inventories

- national plot configuration
- national sampling design covering all forest lands
- national core variable list with standardized measurement protocols
- merger with Forest Health Monitoring Program
- 20% eastern/10% western annual sample
- 5-year reports

# FIA: A 3-phase program

## *Phase 1:*

Entails use of remotely sensed data to obtain initial plot land cover observations and to stratify land areas with the objective of increasing precision

## *Phase 2:*

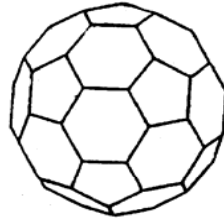
Entails field crew visits to locations of plots with accessible forest to measure traditional suite of mensurational variables

## *Phase 3:*

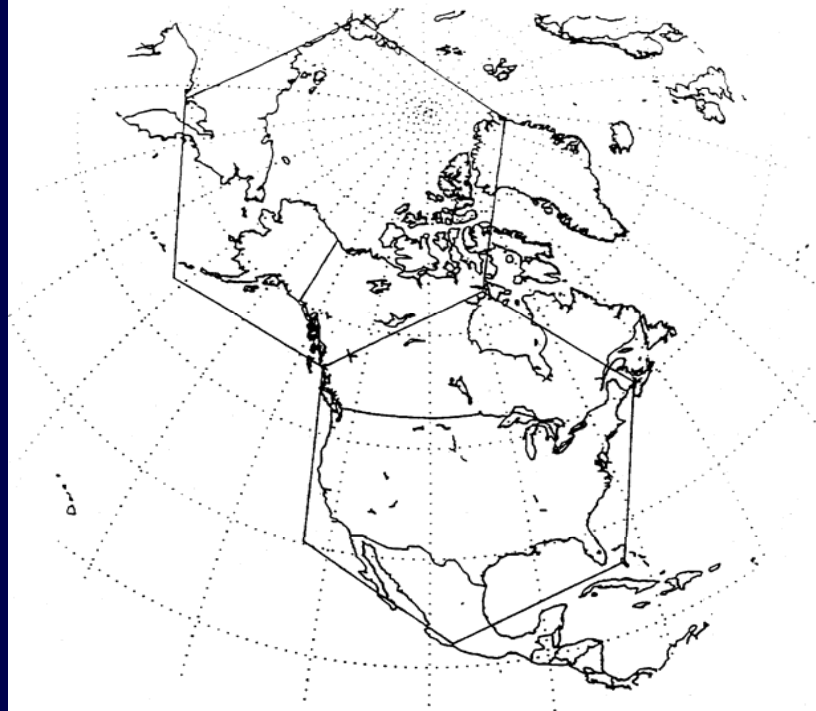
Entails field crew measurements of an additional suite of variables related to the health of the forest on a 1:16 proportion of Phase 2 plots

# The FIA sampling design

# “Mother” Hexagons



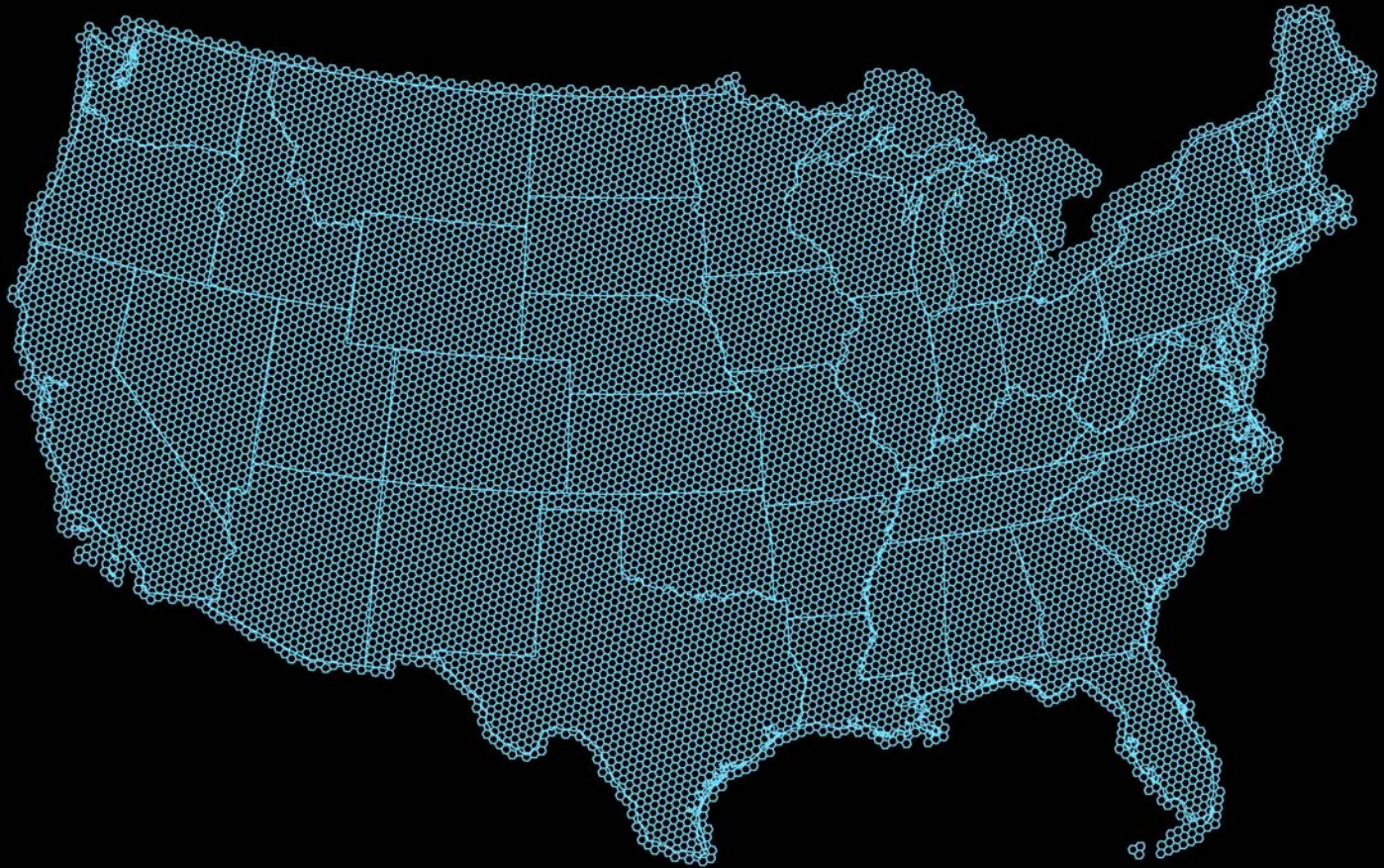
Truncated Icosahedron



Hexagons of the truncated icosahedron covering North America.

*With thanks to:  
Tony Olsen  
US EPA*

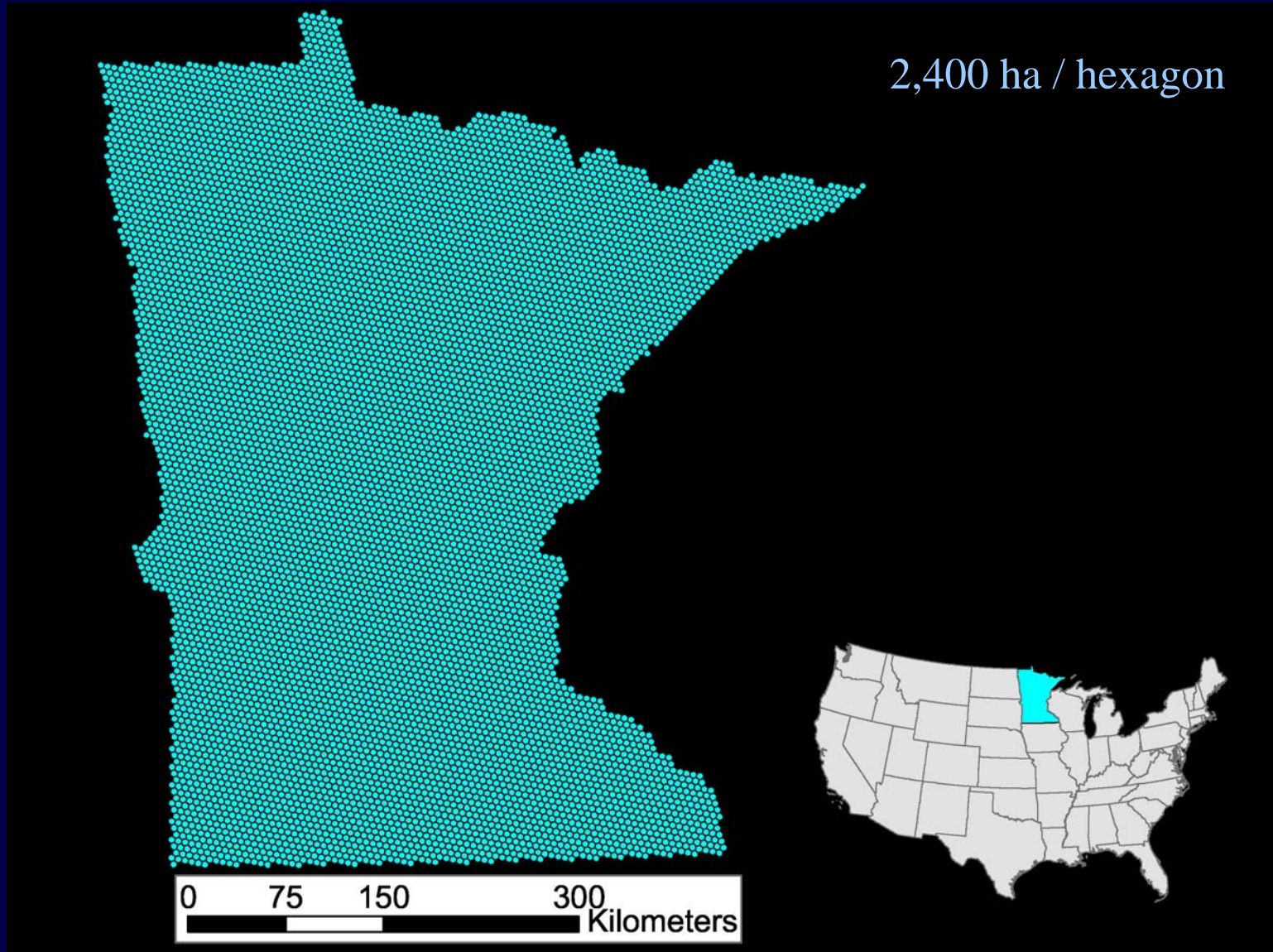
# EMAP / FHM hexagons



65,000 ha / hexagon

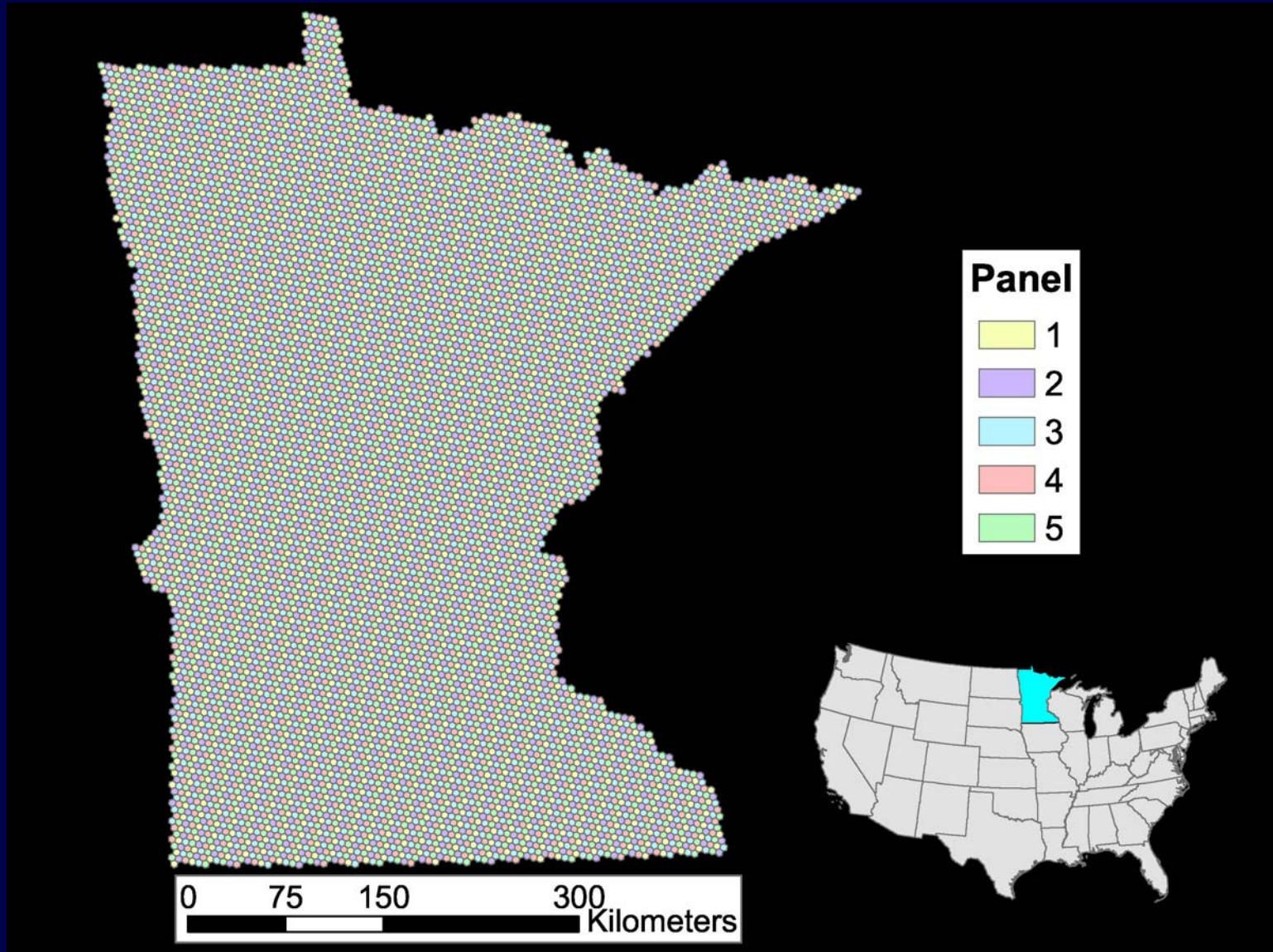


# FIA Phase 2 hexagons

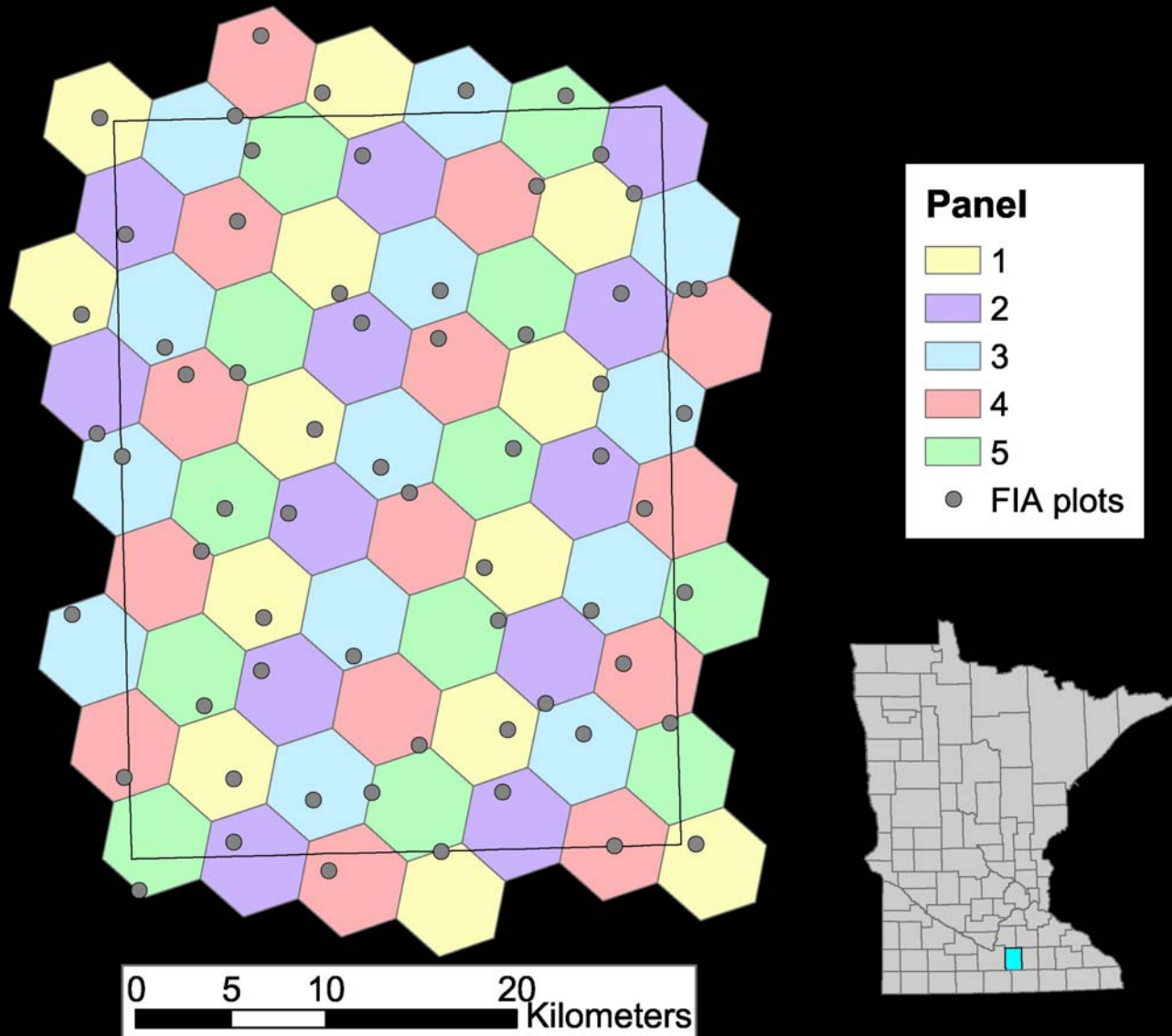




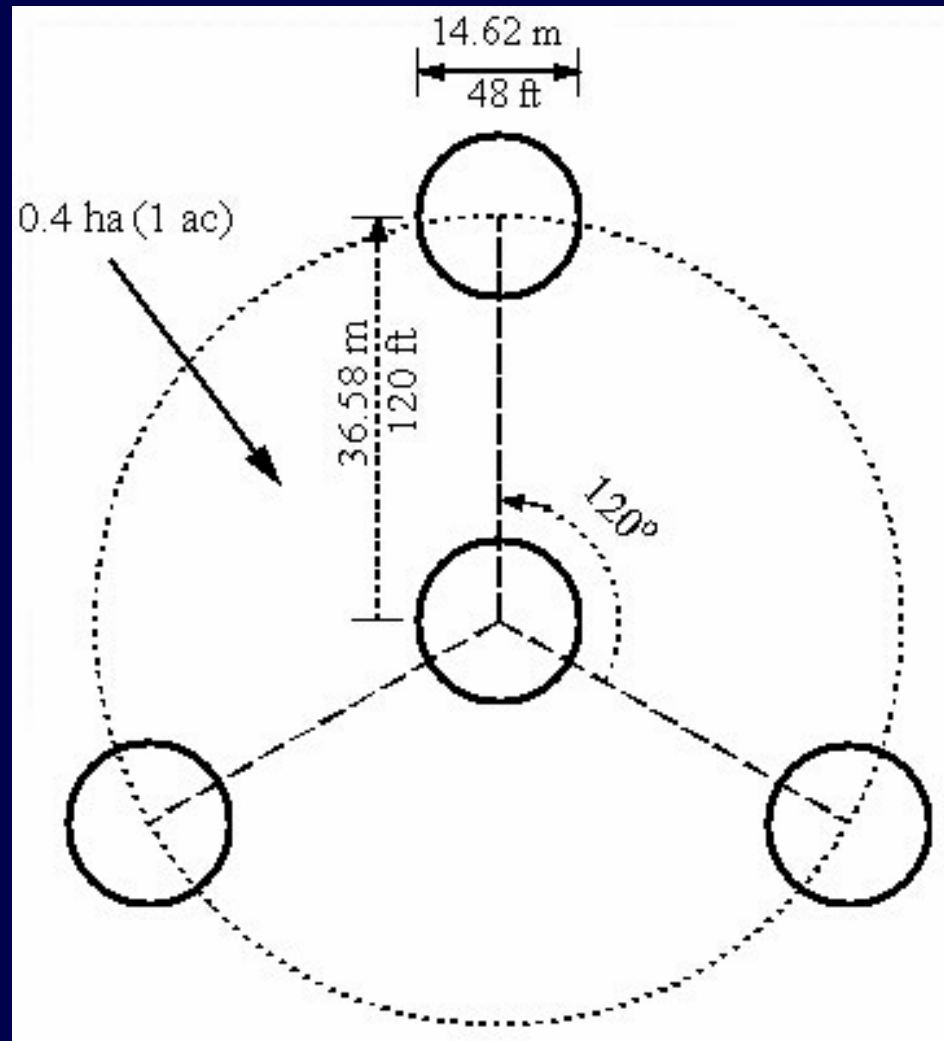
# FIA Phase 2 interpenetrating panels



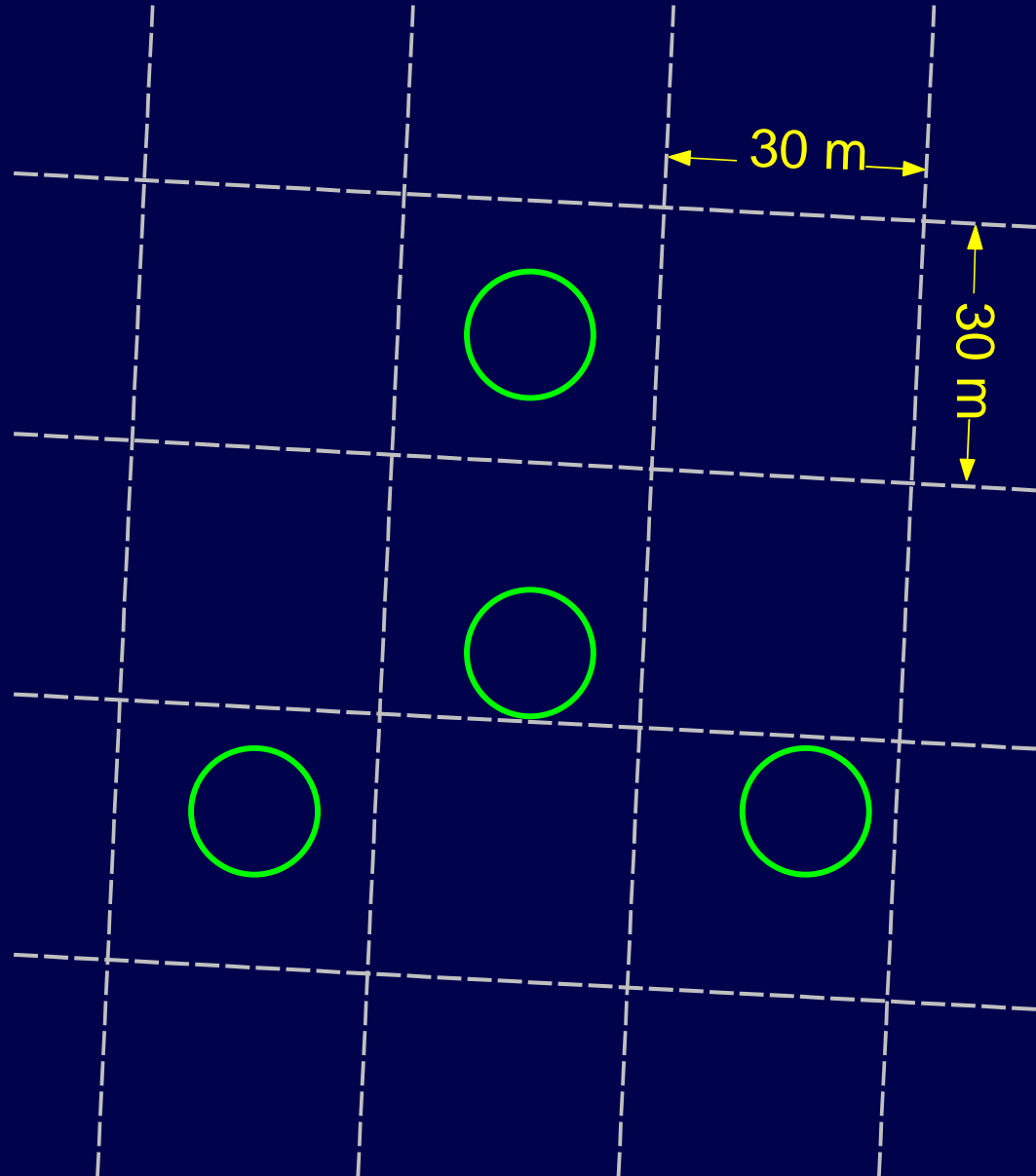
# Base sampling intensity



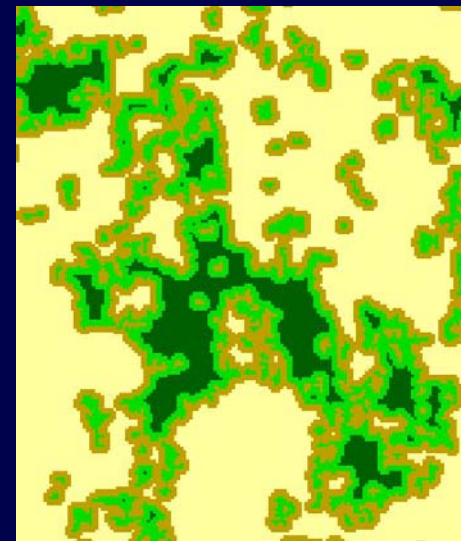
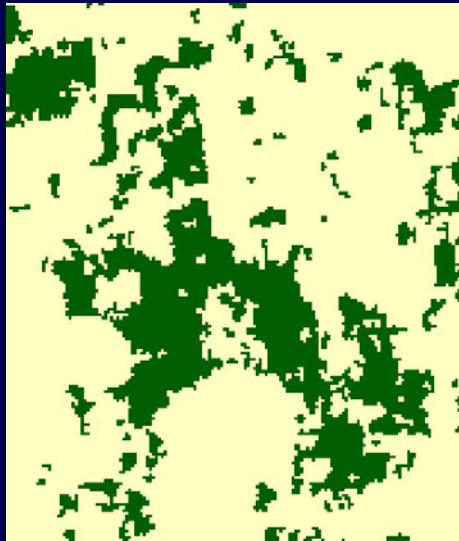
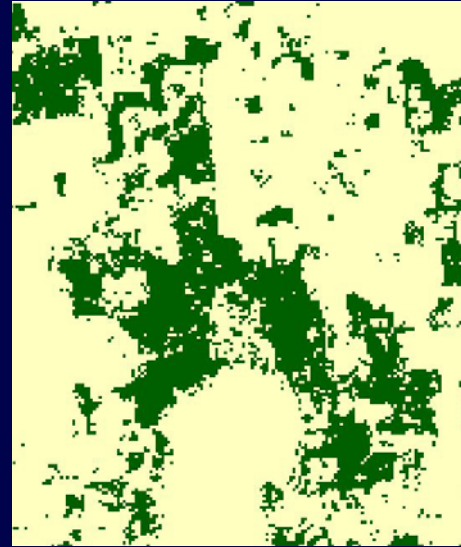
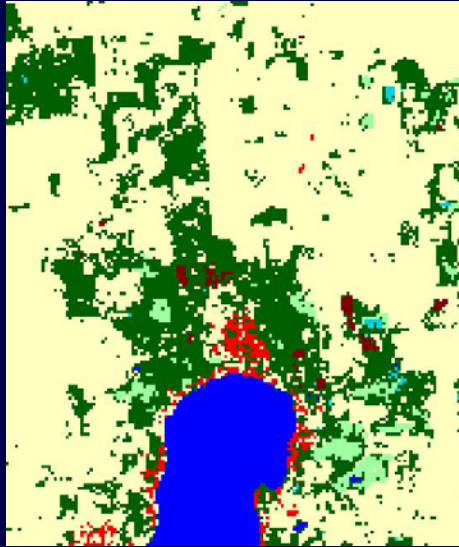
# FIA Plot Configuration



# FIA plot relative to TM pixels

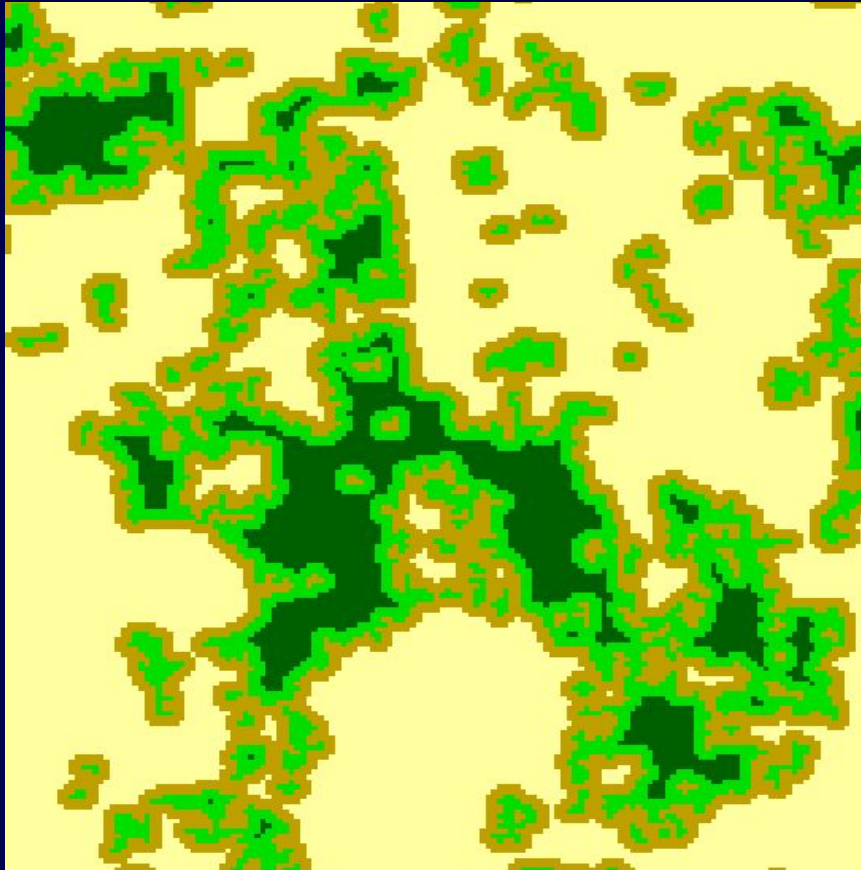


# Phase 1 – Post Stratification





# Land Cover Maps for Stratification



Number of strata    Relative efficiency

	IN	IA	MN	MO
1	1.00	1.00	1.00	1.00
2	2.00	1.68	2.82	2.33
4	3.94	1.89	3.22	2.89

# Pre-field

- Pre-field activities determine which plots fall on accessible forest land.
- Field plots are established only on accessible forest land.

File Edit View Insert Selection Tools Window Help

Standard toolbar icons: New, Open, Save, Print, Cut, Copy, Paste, Undo, Redo, Add Data, Scale (1:15,674,464), Identify, Help, and others.

Navigation toolbar icons: Pan, Zoom In, Zoom Out, Full Extent, Previous View, Next View, Scale (100%), and others.

Geostatistical Analyst | 3D Analyst | Additional tool icons for analysis and visualization.

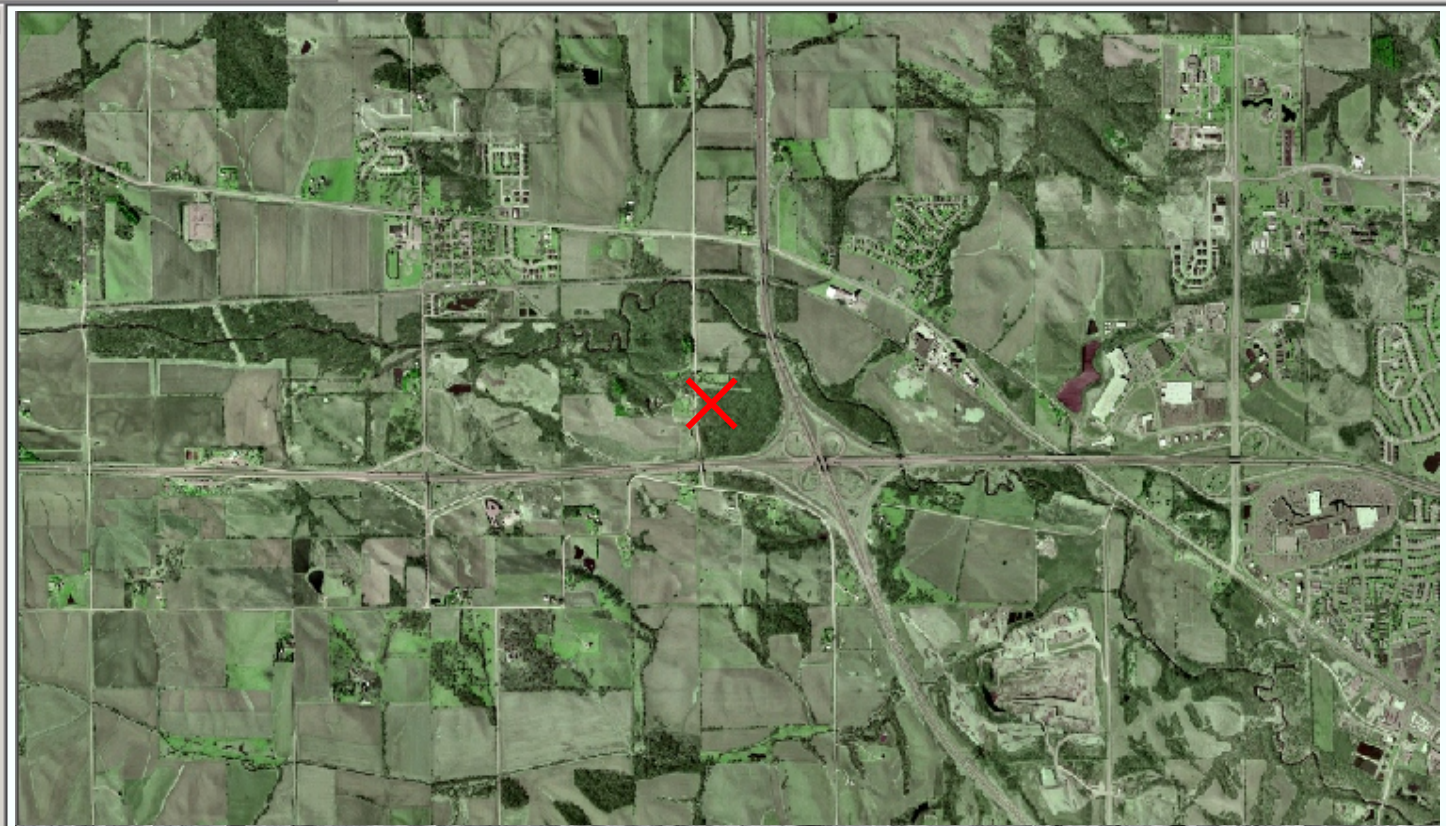
Spatial Analyst | Layer: [dropdown menu] | Additional tool icons.

Editor | Task: Create New Feature | Target: [dropdown menu] | Additional tool icons.

Navigation toolbar icons: Pan, Zoom In, Zoom Out, Full Extent, Previous View, Next View, Scale (100%), and others.

**Layers**

- ☒ DOQ\_DRG\_cat
- ☐ [Red box]



Display Source

Drawing toolbar icons: Line, Polygon, Text, and other drawing tools.



## Phase 2



# FIA Phase 2 observed variables

- Plot/subplot identification and location
- Observed condition (within subplots)
  - *land cover, ownership, forest type, stand age, size class, productivity class*
  - *origin, slope, aspect, physiographic class, disturbance*
- Observed tree attributes
  - *location*
  - *species, status, lean, diameter, height, crown ratio, crown class, damage, decay*

# FIA Phase 2 calculated variables

- Tree attributes
  - *volume*
- Subplot and plot attributes per unit area
  - *number of trees, volume, biomass*
- By category
  - *species/species groups*
  - *status: live, mortality, etc*


# FIA Data

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## Forest Inventory Mapmaker Version 1.7

Estimation Unit Stratum table for all

[ESTN UNIT STRATUM # of records= 3013](#)

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Annual 05 of 05 subcycles

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[MO 05 2003 COUNTY # of records= 116](#)

[MO 05 2003 PLOT # of records= 9484](#)

[MO 05 2003 COND # of records= 11254](#)

[MO 05 2003 TREE # of records= 117351](#)

[MO 05 2003 SUBPLOT # of records= 61286](#)

[MO 05 2003 SEEDLING # of records= 39485](#)

[MO 05 2003 SITETREE # of records= 7395](#)

[MO 05 2003 BOUNDARY # of records= 1257](#)

[MO 05 2003 PLOT POP STRATUM ASSGN # of records= 23139](#)

Internet

# Tabular Summaries

Table 1. -- Area of forest land by forest type group and owner category, Missouri, 1999 - 2002

(In thousand acres)

Forest type group	Owner category			
	All owners	Public	Private	Unidentified owner
<b>Softwood type groups</b>				
White / red / jack pine	2.3	2.3	--	--
Loblolly / shortleaf pine	164.8	100.2	64.5	--
Pinyon / juniper	435.4	27.8	407.6	--
Exotic softwood	1.9	1.9	--	--
All softwood types	604.3	132.2	472.1	--
<b>Hardwood type groups</b>				
Oak / pine	1,013.1	278.5	734.6	--
Oak / hickory	10,633.8	1,959.3	8,674.5	--
Oak / gum / cypress	94.6	13.6	81.0	--
Elm / ash / cottonwood	1,259.2	148.7	1,110.5	--
Maple / beech / birch	797.3	87.7	709.6	--
All hardwood types	13,798.0	2,487.8	11,310.2	--
Nonstocked	51.6	5.4	46.2	--
<b>All forest types</b>	<b>14,453.8</b>	<b>2,625.3</b>	<b>11,828.6</b>	<b>--</b>

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their total due to rounding.

# Traditional Output Products:



That's nice...

...but I need spatially explicit data...

# What FIA Can't Do...

FIA Can't Release

Plot

Location

Coordinates!



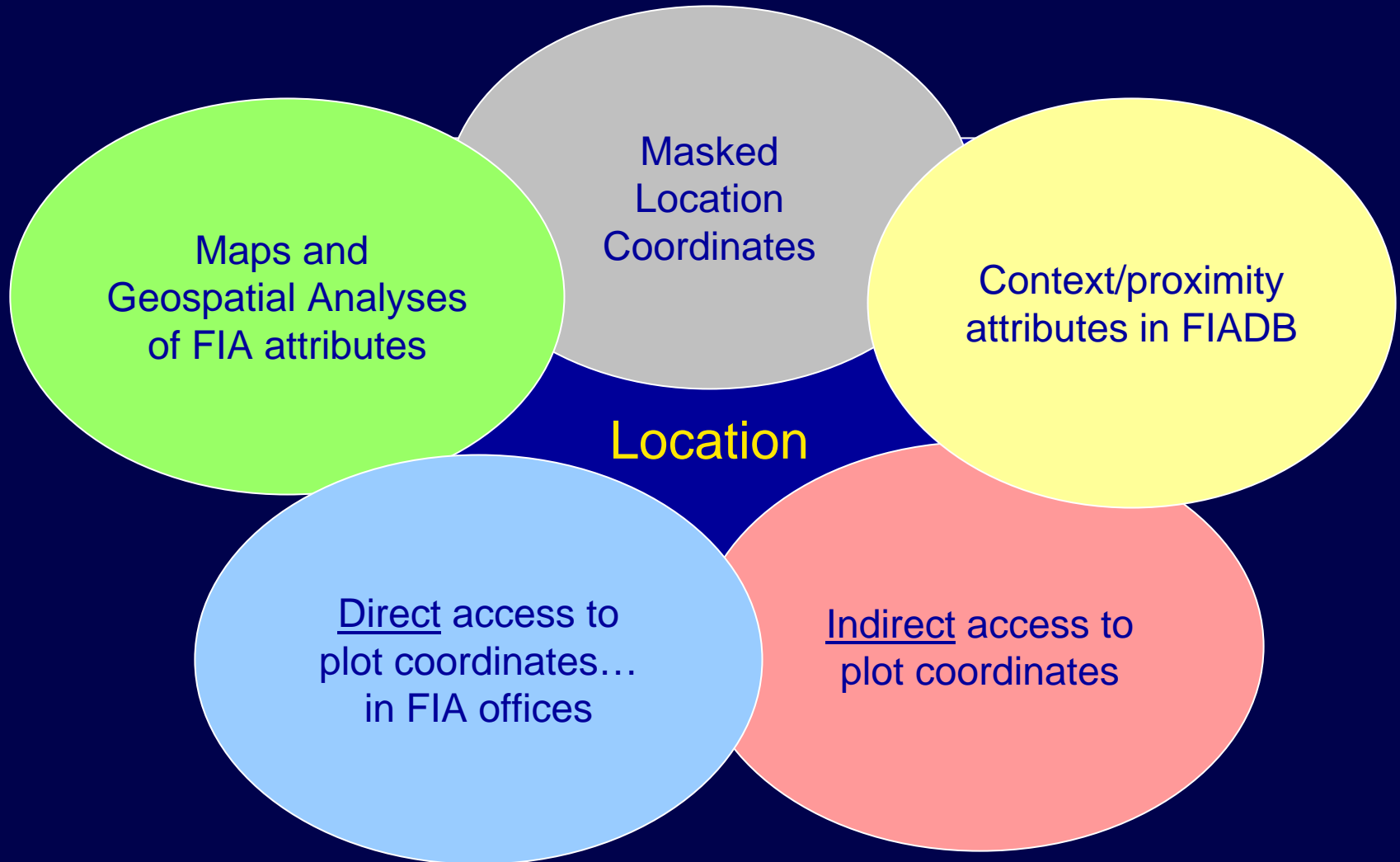
# The Law



- FY 2000 Appropriations Bill (PL 106-113) modified the Food Security Act of 1985 (7 U.S.C. 2276(d))
  - Protects privacy of FIA data suppliers
- Must obscure landowner's identity by:
  - Aggregating data (i.e. estimates)
  - Masking true plot locations
  - Generalizing private ownership types
- Violation of the law can result in fines up to \$10,000 and/or 1 year in jail



# What Can FIA Do?



# FIA Geospatial...

-- Products

-- Services

-- Analyses

# Geospatial Products

The screenshot shows a Microsoft Internet Explorer browser window displaying the 'FIA Data' website. The address bar shows the URL <http://ncrs.fs.fed.us/4801/tools-data/data/>. The website header includes the USDA Forest Service logo and the title 'Forest Inventory and Analysis at the North Central Research Station'. A search bar is present with the placeholder text '(enter query)'. The main navigation menu on the left lists various sections, with 'Tools and Data' currently selected. Under 'Tools and Data', the 'Data' link is circled in red. The main content area is titled 'Tools and Data' and contains three sub-sections: 'Data', 'Mapping Tools and Tablers', and 'Tracking Tools'. The 'Data' section is active and displays information about Phase 3 Data (Forest Health) and 2002 Draft RPA Forest Resources Tables.

USDA FOREST SERVICE

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### Tools and Data

#### Data

##### [Phase 3 Data \(Forest Health\)](#)

We have continued to refine the sample design and measurement methods, and are moving towards incorporating the Phase 3 data seamlessly into the core FIA program. In the near future, our goal is to incorporate these data elements into all public FIA databases, enabling our clients to access all field collected FIA data. Until we achieve that integration, the data processing for Phase 3 data elements occurs on a separate track from the rest of FIA field data.

Phase 3 data collected under both the FHM program (1990 to 1999) as well as FIA (from 2000 onward) is available as comma-delimited ASCII files or as SAS 6.12 data sets.

##### [2002 Draft RPA Forest Resources Tables](#)

RPA Forest Resource Tables provide current information on the Nation's forests. Resource tables present estimates of forest area, volume, mortality, growth, removals, and timber products output in various ways, such as by ownership, region, or State.

##### [Results from the National Woodland Owner Survey](#)

The first set of preliminary tables from the 2002 National Woodland Owner Survey are now available. The focus of much of the information in these tables is family forest owners and, in particular, family forests with total landholdings between 10 and 5,000 acres.

Internet


# Data

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Internet

# Locational Data

Microsoft Excel - fiadb17\_MO\_05\_2003\_PLOT.csv [Read-Only]

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Type a question for help

Font

BO14

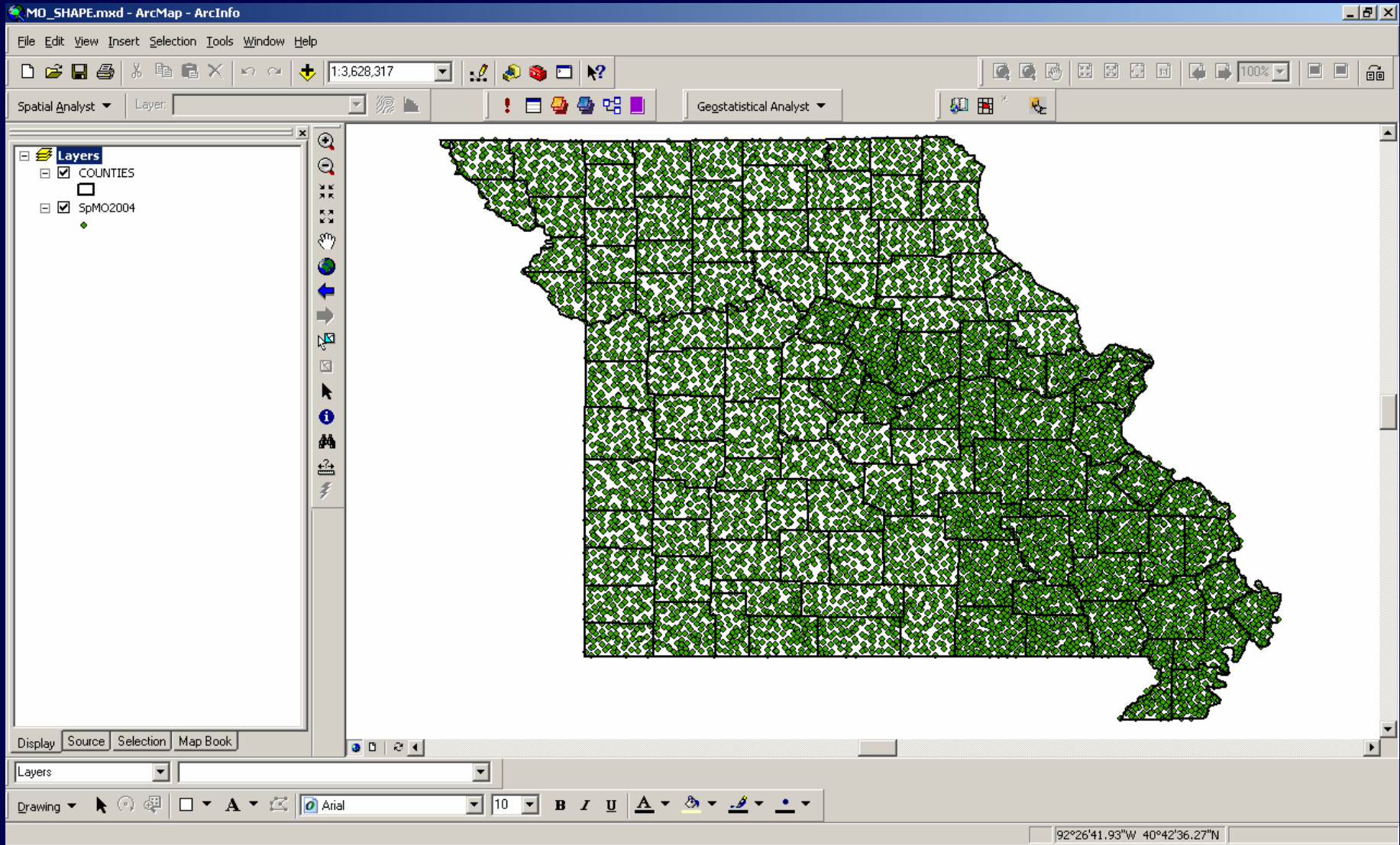
	A	B	C	D	E	F	G	H	V	W	X	AI	AJ
	TABLENM	STATECD	CYCLE	SUBCYCLE	UNITCD	COUNTYCD	PLOT	MEASYEAR	LAT	Lon	ELEV	ECOSUBCD	CONGCD
1	PLOT	29	5	1	4	1	20005	1999	40.213603	-92.854197	988	251Cc	2909
2	PLOT	29	5	2	4	1	20006	2000	40.171762	-92.685759	770	251Cc	2909
4	PLOT	29	5	3	4	1	20007	2002	40.193585	-92.623121	909	251Cc	2909
5	PLOT	29	5	5	4	1	20010	2003	40.103124	-92.585558	965	251Cc	2909
6	PLOT	29	5	1	4	1	20013	1999	40.266488	-92.837046	906	251Cc	2909
7	PLOT	29	5	3	4	1	20015	2001	40.114794	-92.751927	926	251Cc	2909
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9	PLOT	29	5	2	4	1	20023	2000	40.094369	-92.683205	745	251Cc	2909
10	PLOT	29	5	1	4	1	20024	1999	40.298543	-92.660261	807	251Cc	2909
11	PLOT	29	5	1	4	1	20027	1999	40.041407	-92.587044	948	251Cc	2909
12	PLOT	29	5	1	4	1	20028	1999	40.059081	-92.735204	902	251Cc	2909
13	PLOT	29	5	2	4	1	20038	2000	40.251311	-92.804214	1007	251Cc	2909
14	PLOT	29	5	5	4	1	20044	2003	40.272602	-92.716935	925	251Cc	2909

fiadb17\_MO\_05\_2003\_PLOT

Draw AutoShapes

Ready NUM

# Plot shapefiles



# Plot shapefiles

STATEABB	COUNTY	SRCDATE	OWNGROUP	CONDITION	CONDPROP	LAT	LOH	BALIVE	BALIVE_5	TPA_1	TPA_5	ECOSUBCD	CONGC
MO	203	2003	4	1	1	37	-91.54	83.6	56	735	211	223Af	29C
MO	203	2002	4	1	1.0007	37.32	-91.25	82.4	68	601	151	223Af	29C
MO	203	2000	4	1	1.0007	37.14	-91.23	69.8	62	727	126	223Af	29C
MO	203	2004	2	1	1.0007	37.23	-91.13	77.7	74	412	187	223Af	29C
MO	203	2003	4	1	1.0007	37.22	-91.64	82	71	339	114	223Ab	29C
MO	203	2002	2	1	1	37.19	-91.5	81.7	51	777	102	223Af	29C
MO	203	2000	4	1	1.0007	37.17	-91.28	112.9	83	820	145	223Af	29C
MO	203	2004	4	1	1.0007	37.1	-91.63	110.6	73	769	169	223Af	29C
MO	203	2002	4	1	0.6764	37.18	-91.41	33.2	16	579	54	223Af	29C
MO	203	2002	2	2	0.3243	37.18	-91.41	18.9	19	12	12	223Af	29C
MO	203	2002	1	1	1	36.97	-91.3	88.9	64	1338	289	223Af	29C
MO	203	2003	9	1	0.6484	36.93	-91.25	0	0	0	0	223Af	29C
MO	203	2003	1	2	0.3516	36.93	-91.25	30.8	17	336	36	223Af	29C
MO	203	2003	9	1	1	37.41	-91.42	0	0	0	0	223Af	29C
MO	203	2004	4	1	0.7505	37.05	-91.51	56.8	48	408	108	223Af	29C
MO	203	2004	4	2	0.2502	37.05	-91.51	23	23	84	84	223Af	29C
MO	203	2002	2	1	1	37.12	-91.08	82.2	72	522	72	223Af	29C
MO	203	2004	2	1	1.0007	37.12	-91.3	114	110	517	217	223Af	29C
MO	203	2000	4	1	0.821	37.37	-91.53	87.5	68	690	90	223Af	29C
MO	203	2000	9	2	0.1797	37.37	-91.53	0	0	0	0	223Af	29C
MO	203	2004	4	1	0.7505	37.18	-91.59	42.6	37	492	42	223Af	29C
MO	203	2004	4	2	0.2502	37.18	-91.59	34.1	31	204	54	223Af	29C
MO	203	2003	9	2	0.25	37.38	-91.57	0	0	0	0	223Af	29C
MO	203	2003	2	1	0.75	37.38	-91.57	60.7	38	795	120	223Af	29C
MO	203	2002	9	1	1	37.28	-91.64	0	0	0	0	223Ab	29C
MO	203	2002	2	1	1	37.21	-91.34	86.1	75	729	205	223Af	29C
MO	203	2004	1	1	1	36.9	-91.24	127.6	114	423	199	223Af	29C
MO	203	2000	9	1	1	37.2	-91.57	0	0	0	0	223Af	29C
MO	203	2003	2	1	1	37.1	-91.05	33.7	21	1298	24	223Af	29C
MO	203	2001	9	1	1	37.39	-91.63	0	0	0	0	223Af	29C
MO	203	2003	2	1	1	37.31	-91.6	56.2	41	627	102	223Af	29C
MO	203	2002	9	1	0.437	37.13	-91.37	0	0	0	0	223Af	29C
MO	203	2002	4	2	0.5637	37.13	-91.37	37.9	31	234	84	223Af	29C
MO	203	2002	4	1	1.0007	37.15	-91.22	76	50	739	139	223Af	29C
MO	203	2000	4	1	0.5	37.4	-91.19	9	0	150	0	223Af	29C
MO	203	2000	4	2	0.5	37.4	-91.19	27.6	11	399	24	223Af	29C

Record: 8563 Show: All Selected Records (0 out of 11371 Selected.) Options



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### Tools and Data

- Data
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Forest Inventory Mapmaker Ramiform RPA Data Wiz

### Mapping Tools and Tablers

The **Mapmaker program** produces tables and maps from the National FIA\*, Resource Planning Act (RPA) or Timber Products Output (TPO) databases.

This program provides the user with the ability to easily generate tables and maps by using a web browser, without the need for an understanding of the underlying data structures. The web application generates the resulting table of forest statistics. If the user selects County code or Congressional District as the row variable, a shaded county map or shaded congressional district map is generated.

The user inputs the following information:

- geographic area of interest (state/county retrieval or radius retrieval)
- attribute of interest (timberland area, number of trees, growing-stock volume, etc.)
- optional filters (for restricting the query to a specific ownership, species, etc.)

Graphic example of the output from the Forest Inventory Mapmaker program.

<http://www.ncrs2.fs.fed.us/4801/FIADB/index.htm> Internet

## Web

# Ramiform



# Desktop

# Geospatial Services

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Address [http://www.fs.fed.us/ne/fia/spatial/index\\_ss.html](http://www.fs.fed.us/ne/fia/spatial/index_ss.html) Go Links >>

USDA FOREST SERVICE Forest Service National Links go

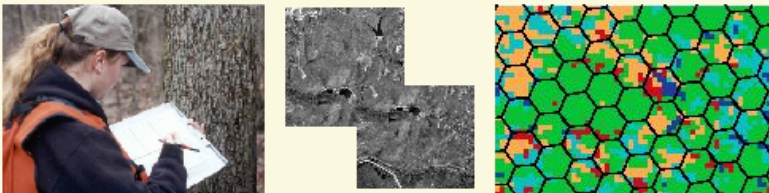
## National Forest Inventory and Analysis Spatial Data Services

Search  go

- ▼ FIA SDS Home Page
  - ▶ Charter
  - ▶ How to Request
  - ▶ Examples of Requests
  - ▶ Completion Time
  - ▶ Requests & FIA Units
  - ▶ FIA Map Maker
  - ▶ FIA SDS Site Map
  - ▶ National FIA
  - ▶ Other Links



**National FIA Spatial Data Services**  
Louis C. Wyman Forestry Sciences Laboratory  
271 Mast Road  
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Durham, NH 03824  
**Contact:**  
Elizabeth LaPoint  
**Email:**  
[elapoint@fs.fed.us](mailto:elapoint@fs.fed.us)  
(603)868-7675

**Welcome...**



**Introduction**  
A point of contact for Forest Inventory and Analysis, called National Forest Inventory and Analysis Spatial Data Services is located in Newtown Square, PA. FIA SDS was created to facilitate access to FIA data without compromising the security of the plot locations or land owner privacy. We connect geospatial data submitted by interested parties to the geospatial information collected by FIA. We return data to the customer that both meets their needs and follows the confidentiality laws set out by Congress. FIA data is a valuable resource that we feel should remain accessible within the law.

For more information about FIA Spatial Data Services, how we operate and some examples of our work, please see the sidebar links.



Internet

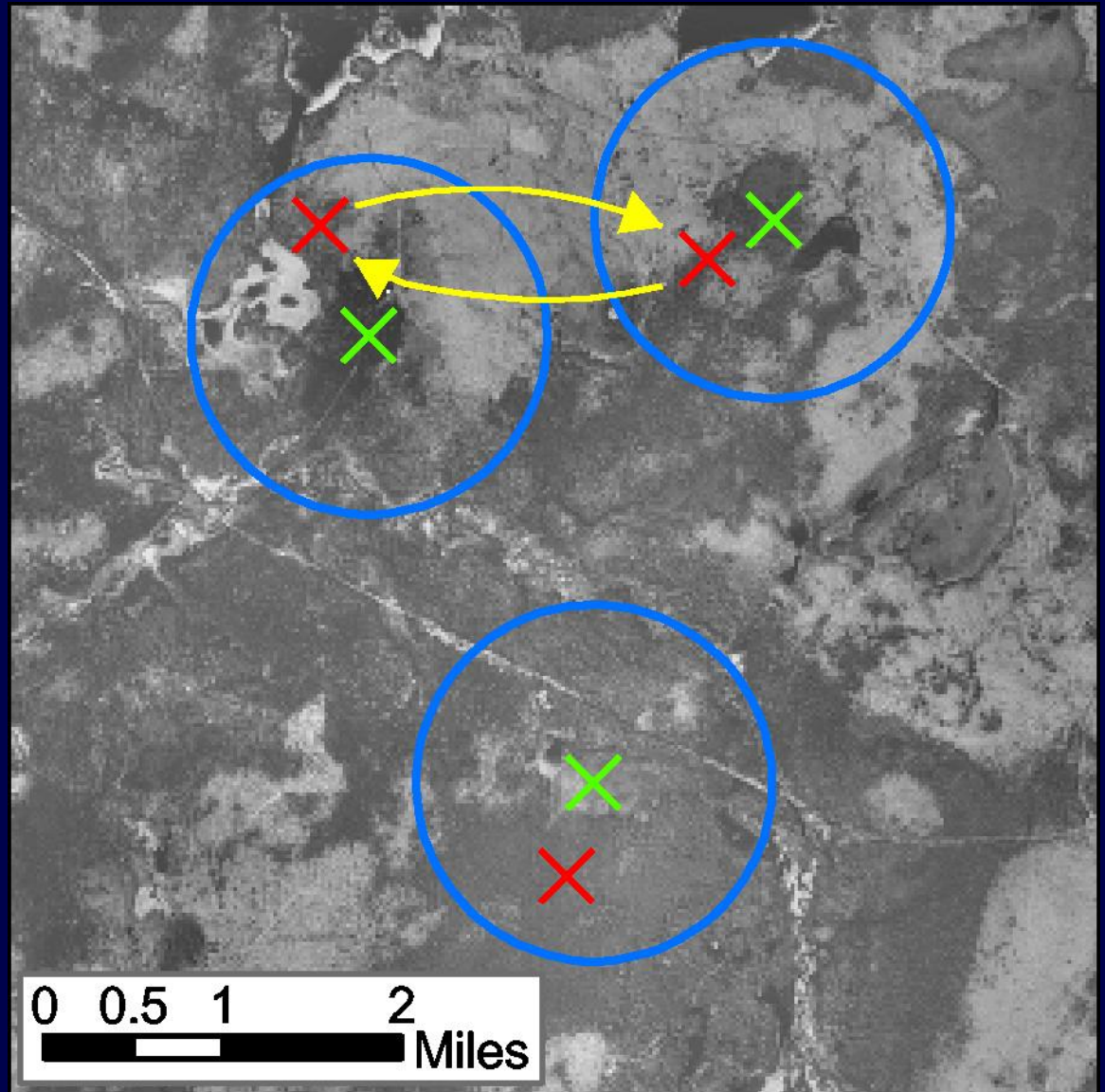
# Spatial Data Services

- Facilitate the use of FIA plot locations by the public for conducting spatial analyses while:
  - Protecting landowner privacy
  - Maintaining plot integrity

# Masking plot locations

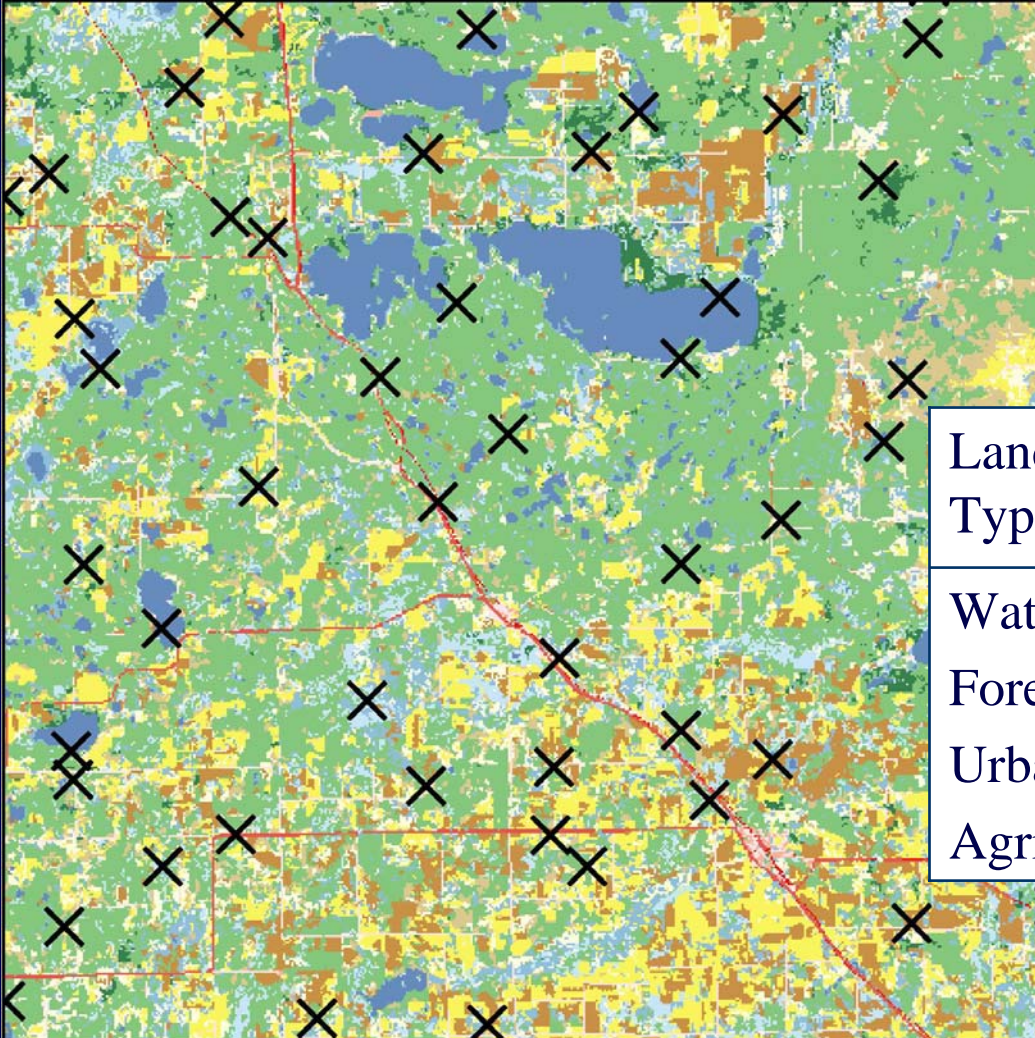
- True locations masked to within 1 mile; many are within  $\frac{1}{2}$  mile.

- Private plots with similar characteristics may be swapped.





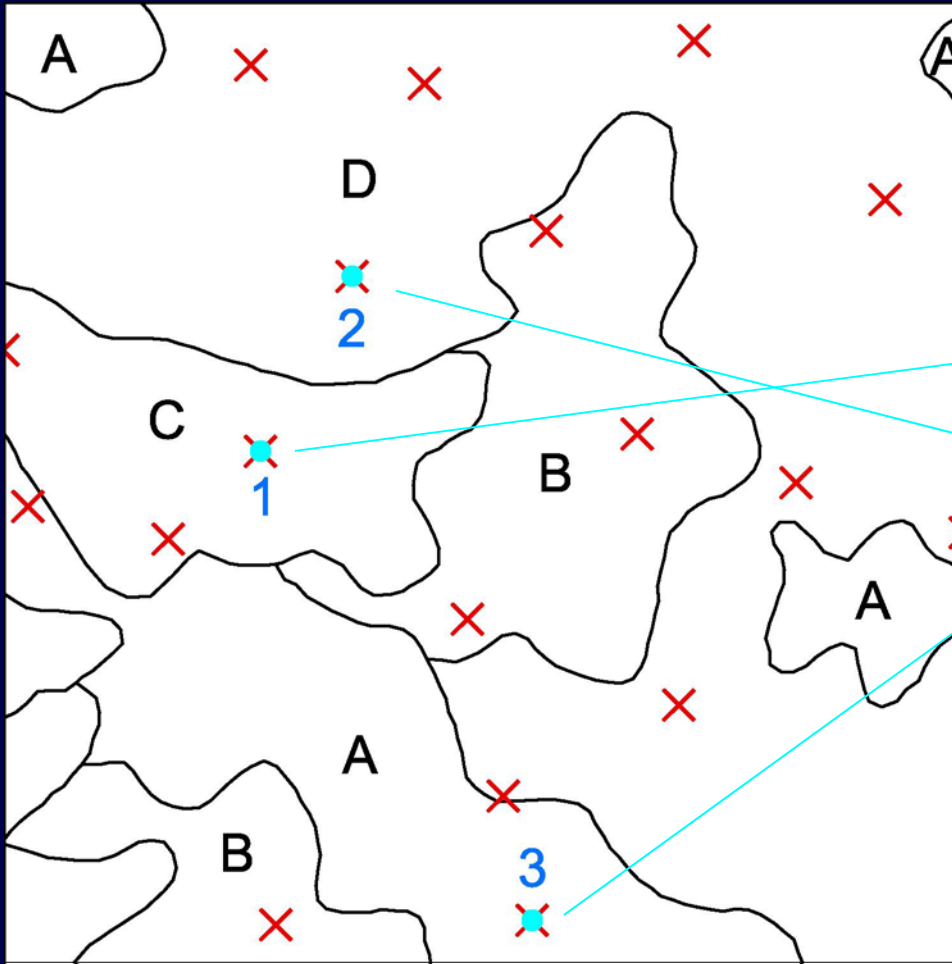
# Summarizing FIA attributes by polygon or raster value



Land Cover Type	Plot Count	Ash (per acre)
Water	10	0.5
Forest	30	75
Urban	5	15
Agriculture	25	30

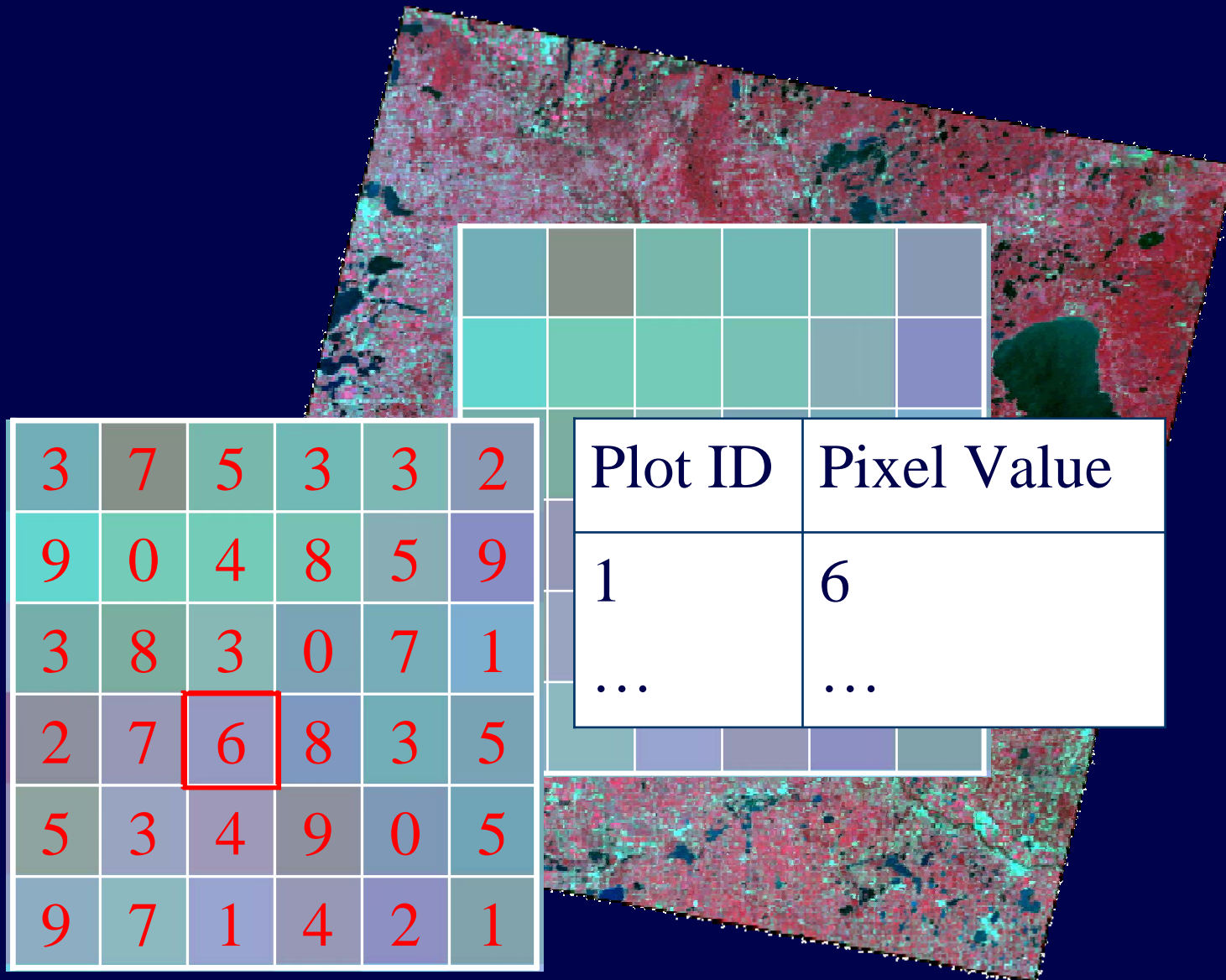


# Linking plot IDs with geospatial data sets



Plot ID	Polygon Value
1	C
2	D
3	A

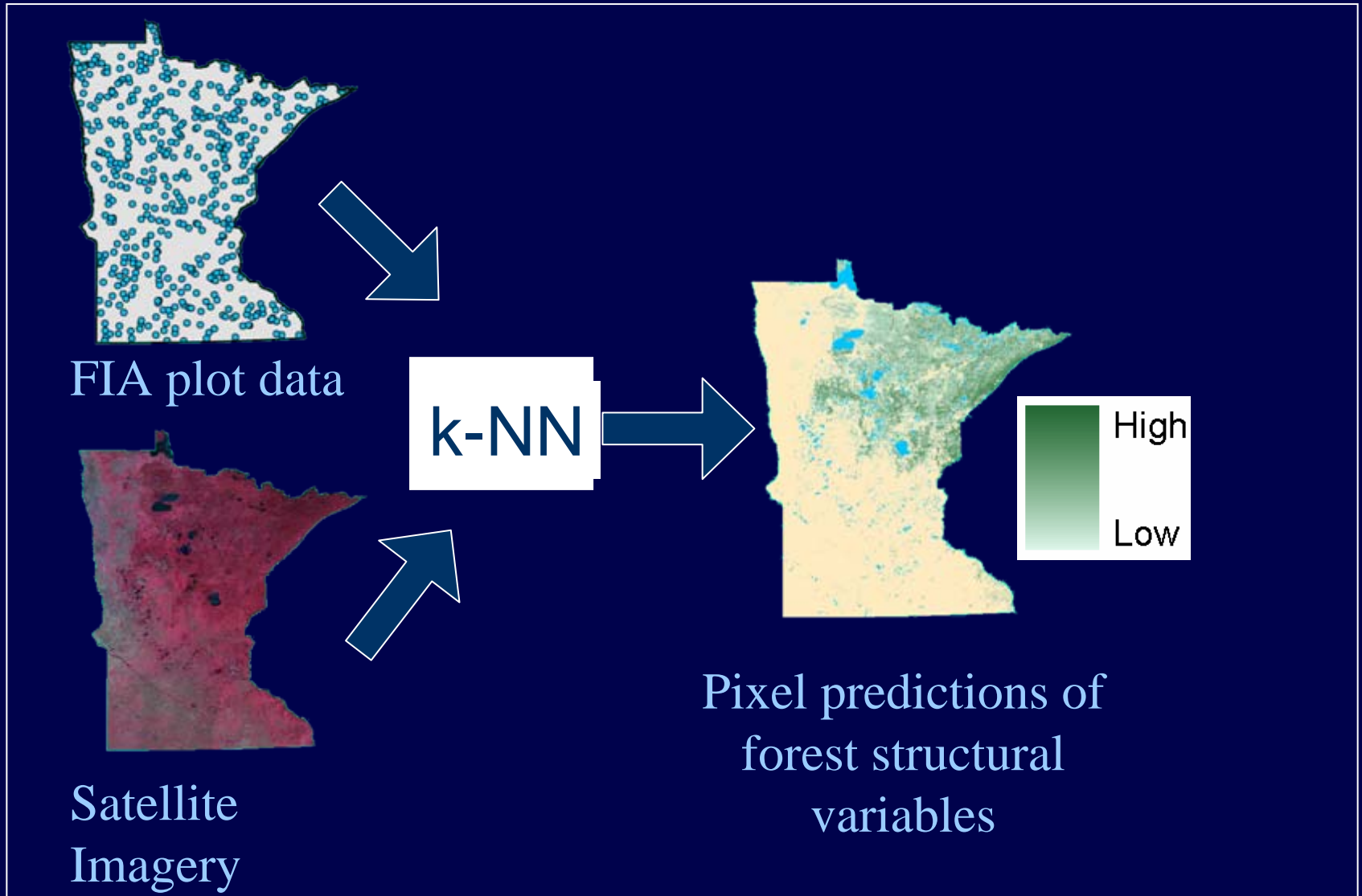
# Linking plot IDs with image data



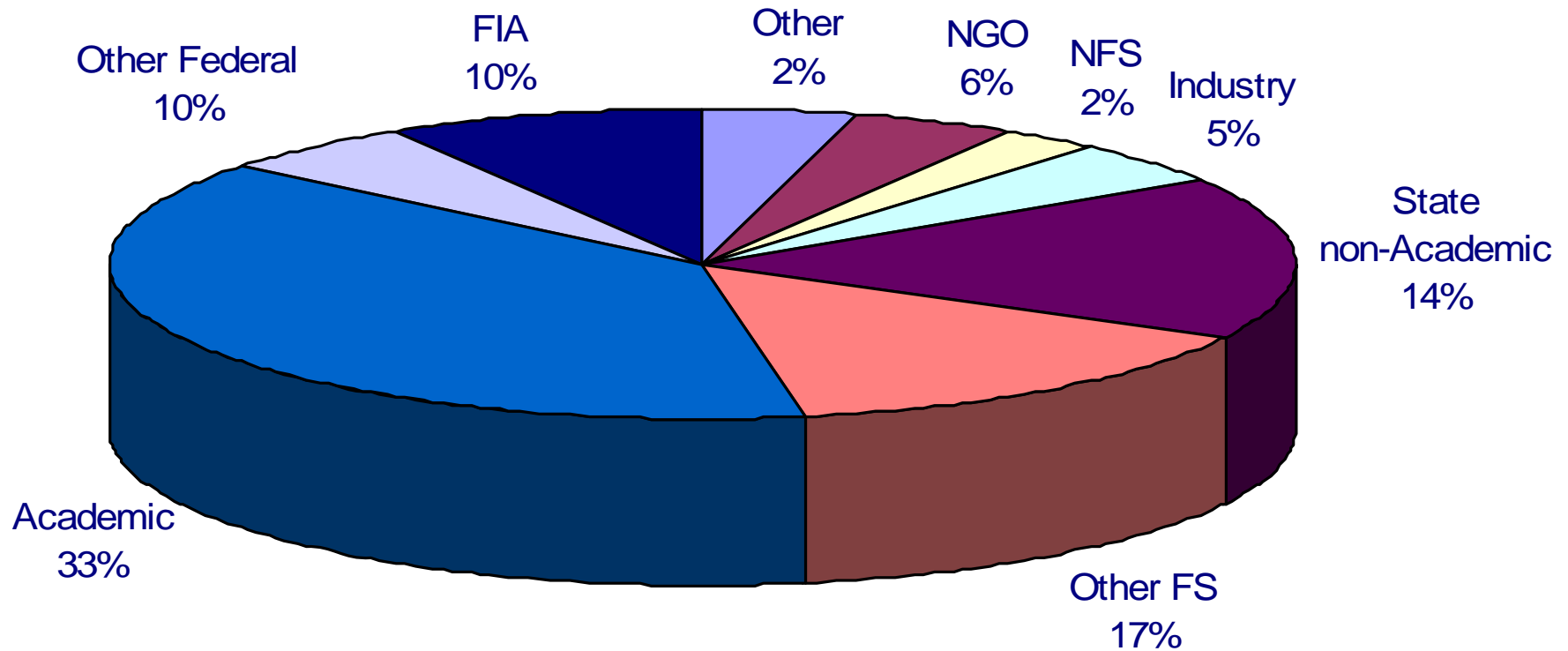
# Hosting customers



# Complex analyses

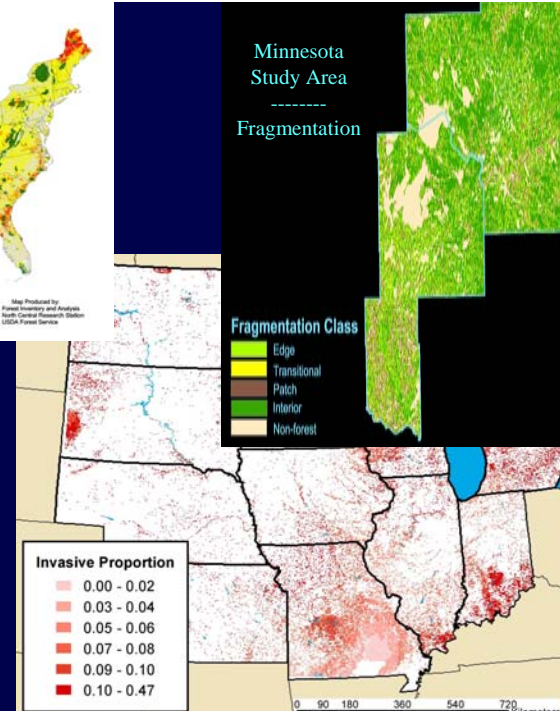
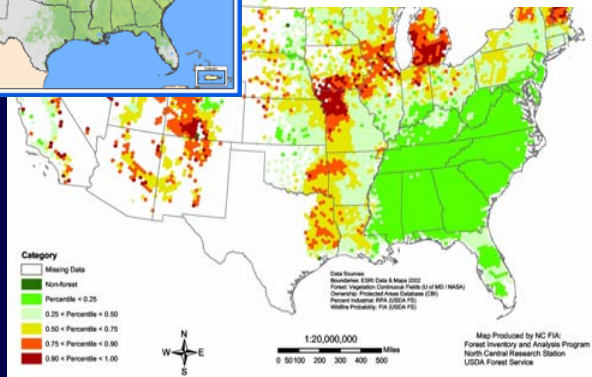
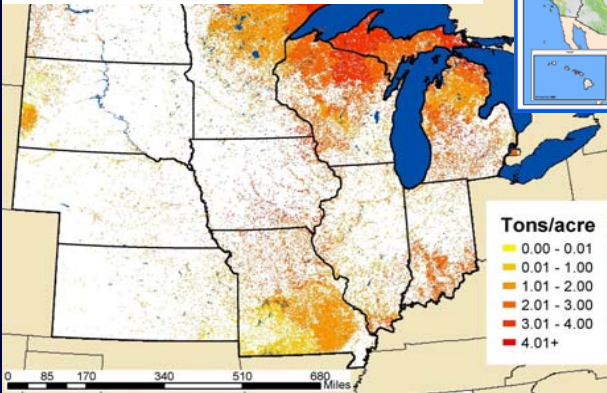
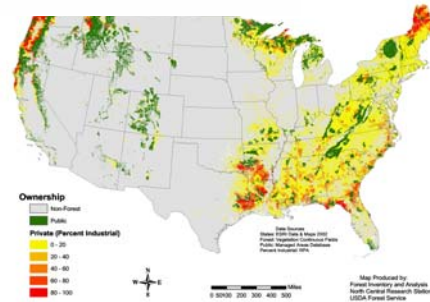
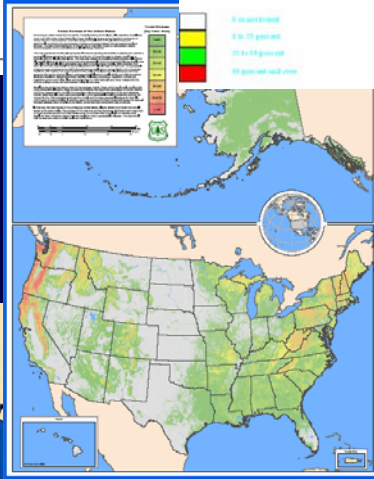
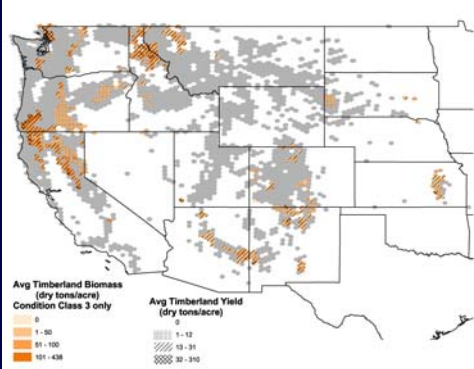
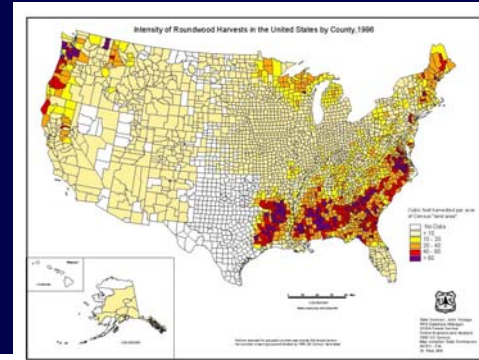
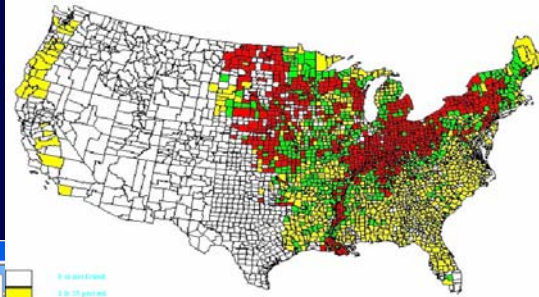
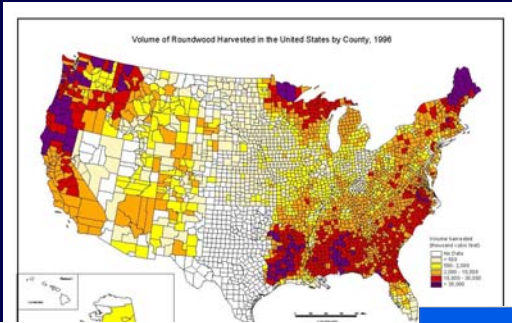


# Requests by Organization (2002 – present)



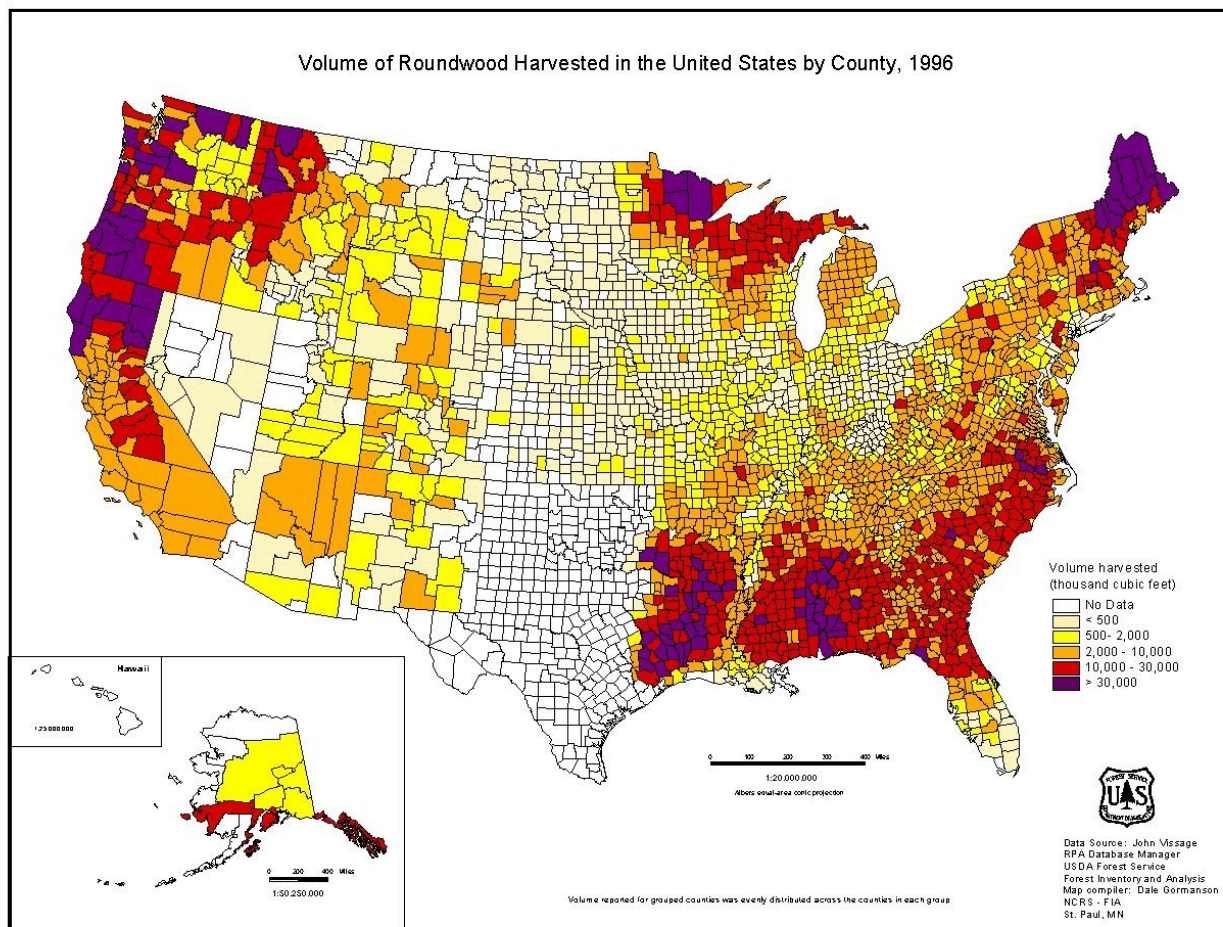


# Geospatial Analyses





# FIA County Maps



# Rudis (2003)

United States  
Department of  
Agriculture  
Forest Service



Southern  
Research Station  
General Technical  
Report SRS-70

## **Comprehensive Regional Resource Assessments and Multipurpose Uses of Forest Inventory and Analysis Data, 1976 to 2001: A Review**

**Victor A. Rudis**



United States  
Department of  
Agriculture



Southeastern Forest  
Experiment Station

Forest Service  
Research Paper SE-218

# Multiresource Inventories: Techniques for Evaluating Nongame Bird Habitat

by Raymond M. Sheffield



# Sheffield (1981)

- Much of the typical timber-related data collected for the past several years on ... sample plots are useful for evaluating wildlife habitat.”

# Sheffield (1981)

- Presence or absence of breeding birds can be related to:
  - Stand age
  - Forest type
  - Physiographic class
  - Stand size
  - Presence of cull trees
  - Timber volume
  - Tree stocking

# Habitat suitability

- Each inventory plot is ranked for each bird species:
  - Good
  - Acceptable
  - Poor
  - Unsuitable



# *Brown-headed Nuthatch*

## *Unsuitable habitats.*

1. Stand age is less than 20 years.
2. Less than 50 percent of the total basal area is made up of pine species.
3. Pine vegetative stocking in all 1-foot strata in the overstory is less than 40 percent.

# *Brown-headed Nuthatch*

## *Suitable habitats.*

1. Stand age:
  - a. 60 years or more (3)
  - b. 40-59 years (2)
  - c. 20-39 years (1)
2. Proportion of total basal area made up of pine species:
  - a. 80 percent or more (3)
  - b. 65-79 percent (2)
  - c. ~~50-64~~ percent (1)
3. Vegetative stocking in 1-foot stratum of highest density in the ~~2-~~ to ~~15-~~foot vertical layer:
  - a. 0-30 percent (3)
  - b. ~~31-60~~ percent (2)
  - c. 61 percent or more (1)
4. Pine vegetative stocking in 1-foot stratum of highest density in the overstory layer:
  - a. 80 percent or more (3)
  - b. 60-79 percent (2)

- c. 40-59 percent (1)
5. History of fire occurrence on sample stand:
  - a. Burned within past year (3)
  - b. Burned 1 to 3 years ago (2)
  - c. Burned over 3 years ago, or no history of fire (1)

# *Brown-headed Nuthatch*

## *Habitat Rank Determination*

<i>Habitat rank</i>	<i>Code</i>	<i>Total accumulated points</i>
Good	3	13-15
Acceptable	2	9-12
Poor	1	5-8
Unsuitable	0	0

# *Brown-headed Nuthatch*

DISTRIBUTION OF SUITABLE  
BROWN-HEADED NUTHATCH HABITAT  
BY SUITABILITY CLASS, SOUTH CAROLINA, 1978

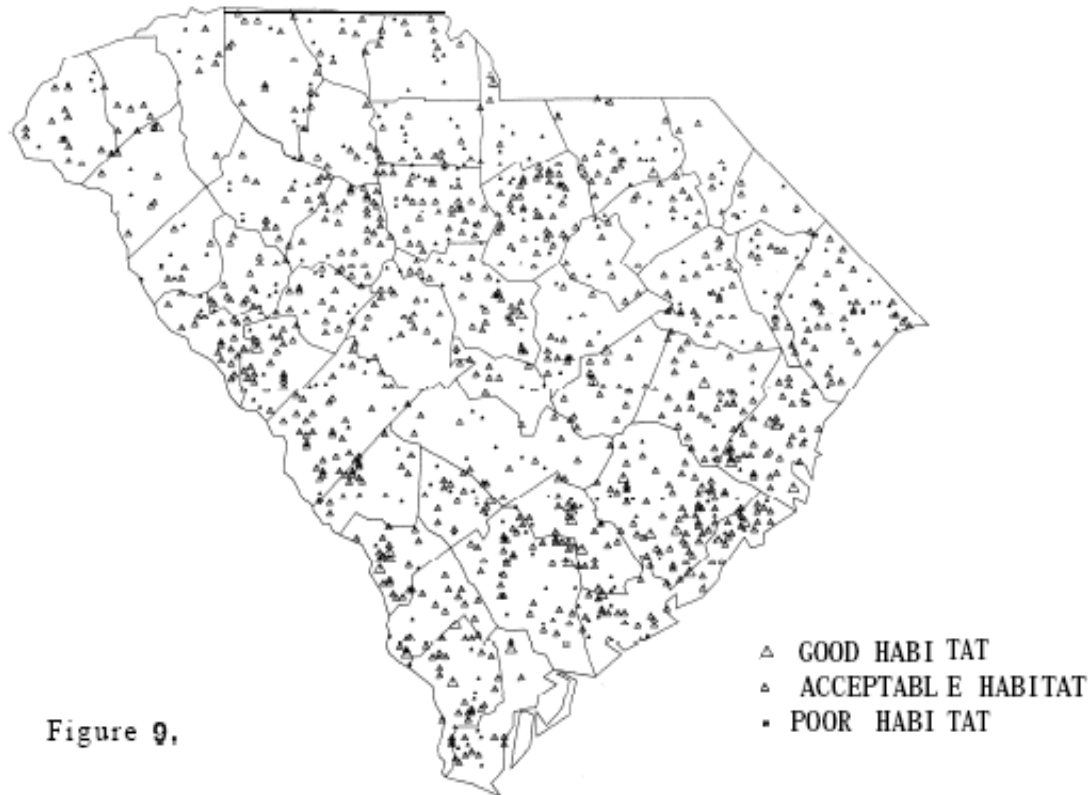
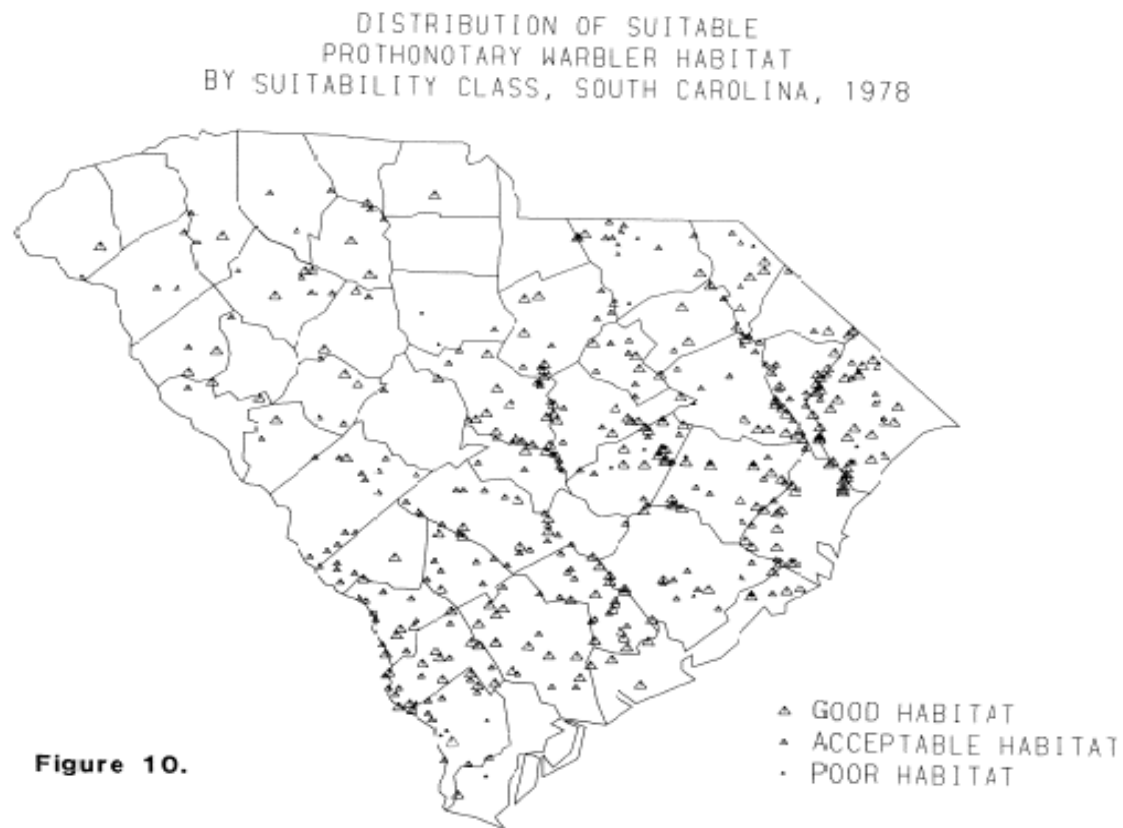


Figure 9,

# *Prothonotary Warbler*



**Figure 10.**

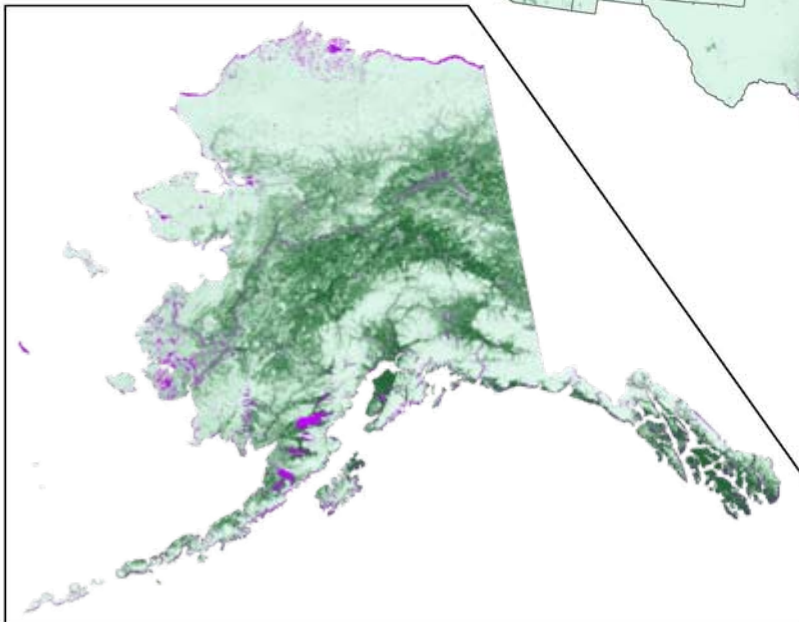
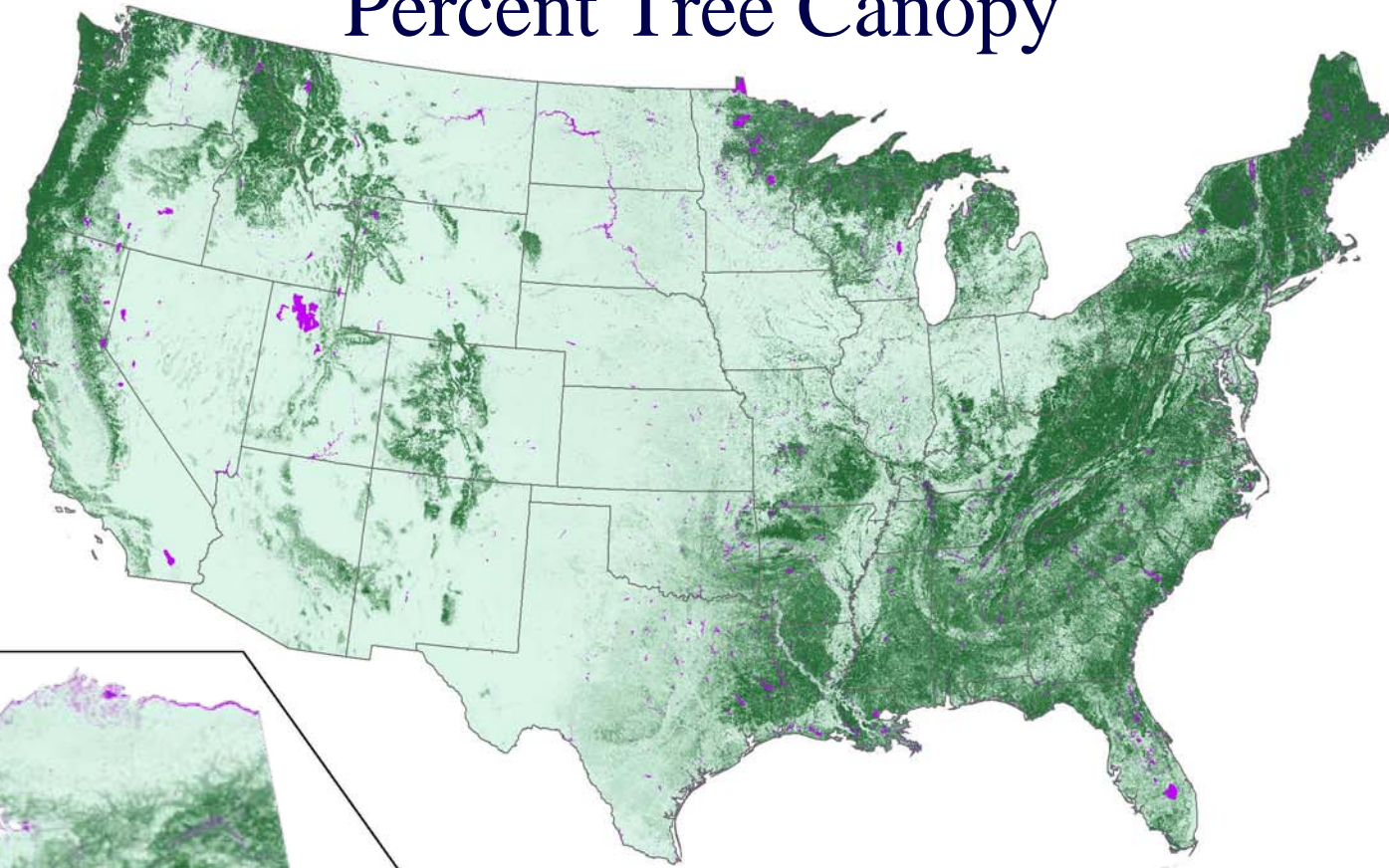
# Inventory plot-based estimates

Table Z.-Acreage of suitable and unsuitable nongame bird habitat, by suitability rank and species, South Carolina, 1978

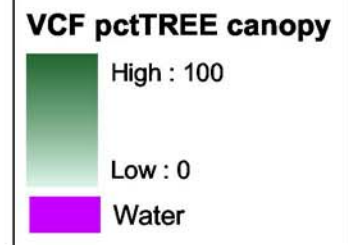
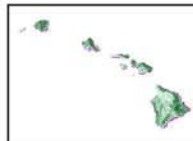
Species	Total	Suitability rank			
		Good	Acceptable	Poor	Unsuitable
----- Thousand acres -----					
Prairie warbler	12,502.9	1,165.6	1,246.8	759.5	9,331.0
Wood thrush	12502.9	646.2	3,368.2	2,135.5	6,353.0
Pine warbler	12,502.9	1,823.0	2,633.1	825.0	7,221.8
Red-eyed vireo	12,502.9	1,418.9	3,400.4	659.9	7,023.7
Pileated woodpecker	12502.9	329.0	1,651.1	1,228.1	9,294.7
Downy woodpecker	12,502.9	431.1	3,760.9	2,541.7	5,769.2
Brown-headed nuthatch	12,502.9	101.5	2,680.5	933.9	8,787.0
Prothonotary warbler	12,502.9	606.9	661.8	42.2	11,192.0
Eastern bluebird	12,502.9	147.4	613.1	731.7	11,010.7



# Vegetation Continuous Fields (VCF) Percent Tree Canopy



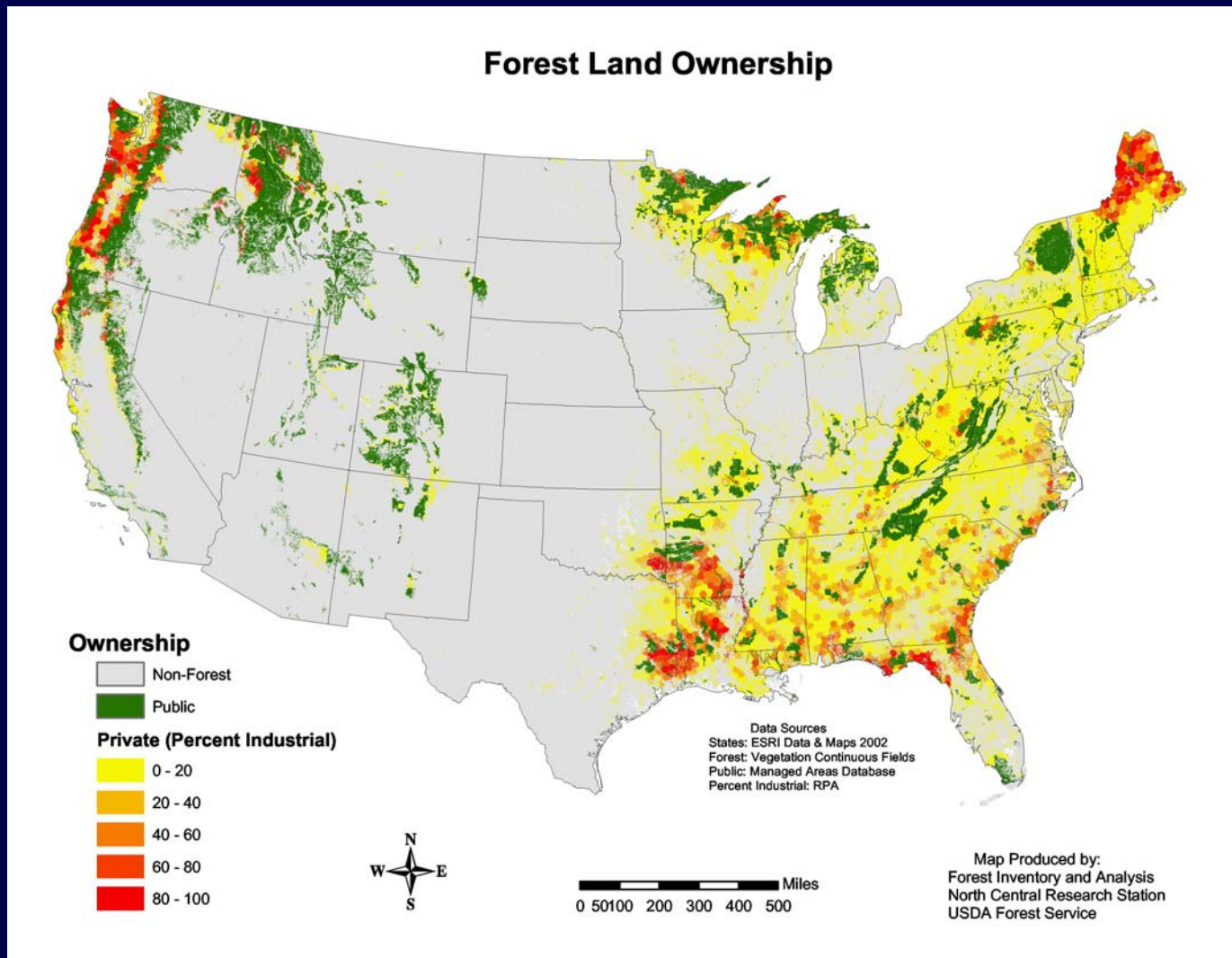
N  
1:25,000,000  
Albers Equal Area



Data sources:  
ESRI Data & Maps 2002  
Vegetation Continuous Fields 2001



# Forest Land Ownership



# Forest Biomass in the United States



# Chojnacky (2000)

- FIA Forest Inventory Data for Wildlife Habitat Assessment.

Thomas C. Edwards, Jr., Gretchen G. Moisen,  
Tracey S. Frescino, and Joshua J. Lawler

- Use of Forest Inventory and Analysis information in wildlife habitat modeling: a process for linking multiple scales.

# Fearer

- Evaluating Population-Habitat Relationships of Forest Breeding Birds at Multiple Scales Using Forest Inventory and Analysis Data.



Todd Farrand, John Tirpak,  
Frank Thompson

- Application of FIA data to spatial modeling of landscape change and bird habitat suitability.

In conclusion,  
FIA is providing...

- Products
- Services
- Analyses

*To serve your geospatial needs.*

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651-649-5104